

FIG. 3

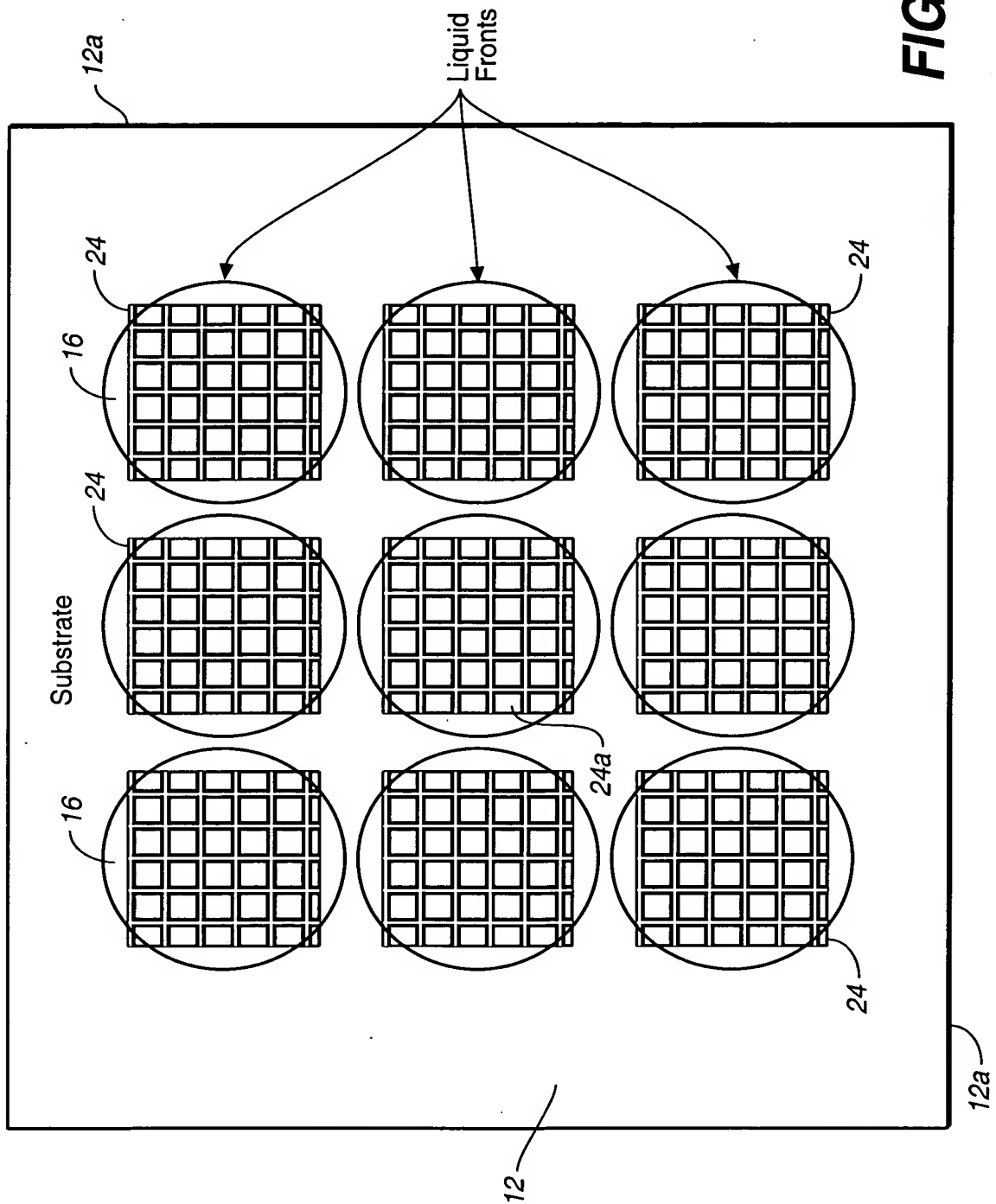


FIG. 4

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FIG._5

1. Process Flow

L / D Preparation

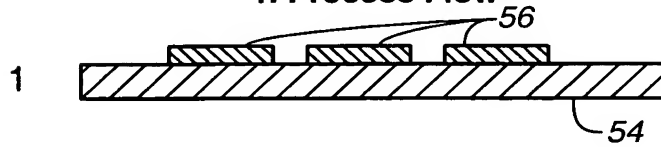


FIG._6

2. Process Flow

Bonding Sheet
Tack Lam

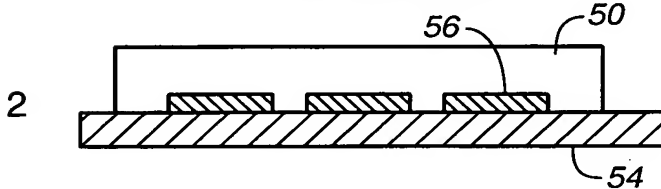


FIG._7

3. Process Flow

Laser Drill of
Lithography

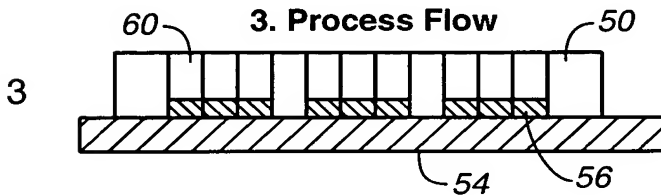


FIG._8

4. Process Flow

Align DDF
to L / D

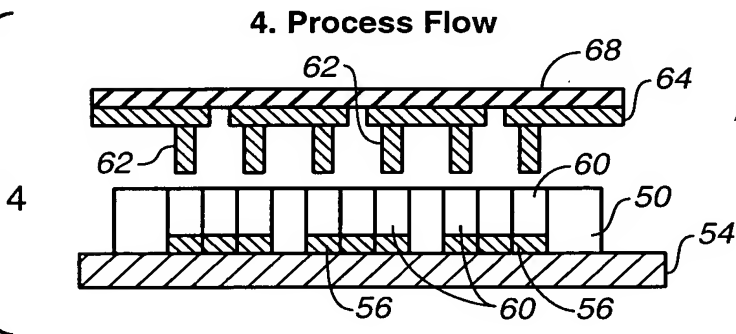


FIG._9

5. Process Flow

Attach DDF
to L / D
by Heat

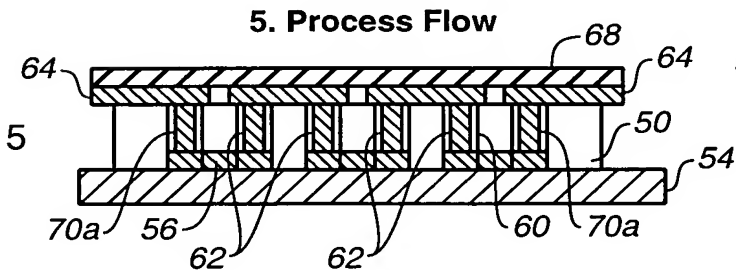
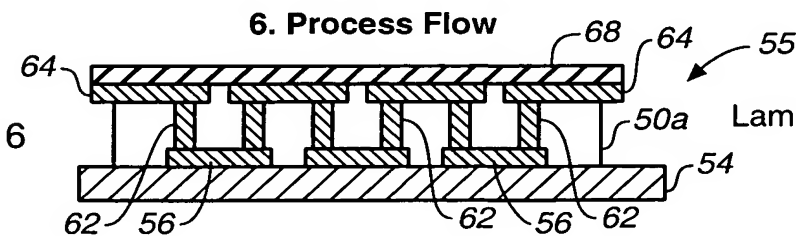


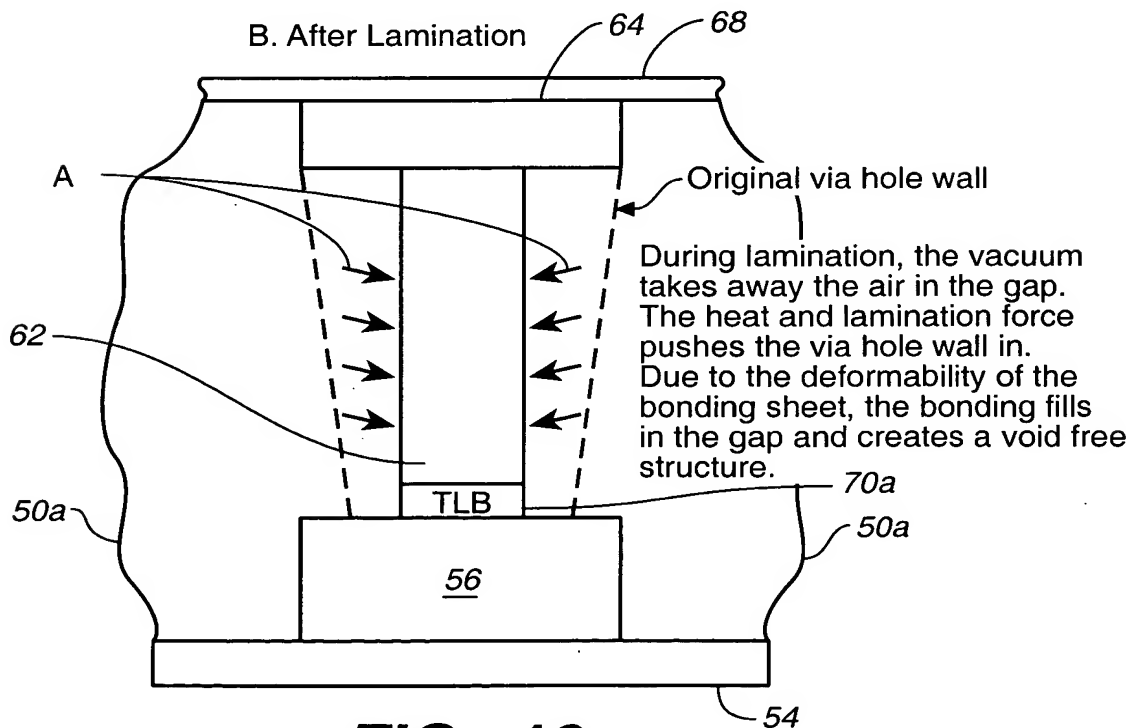
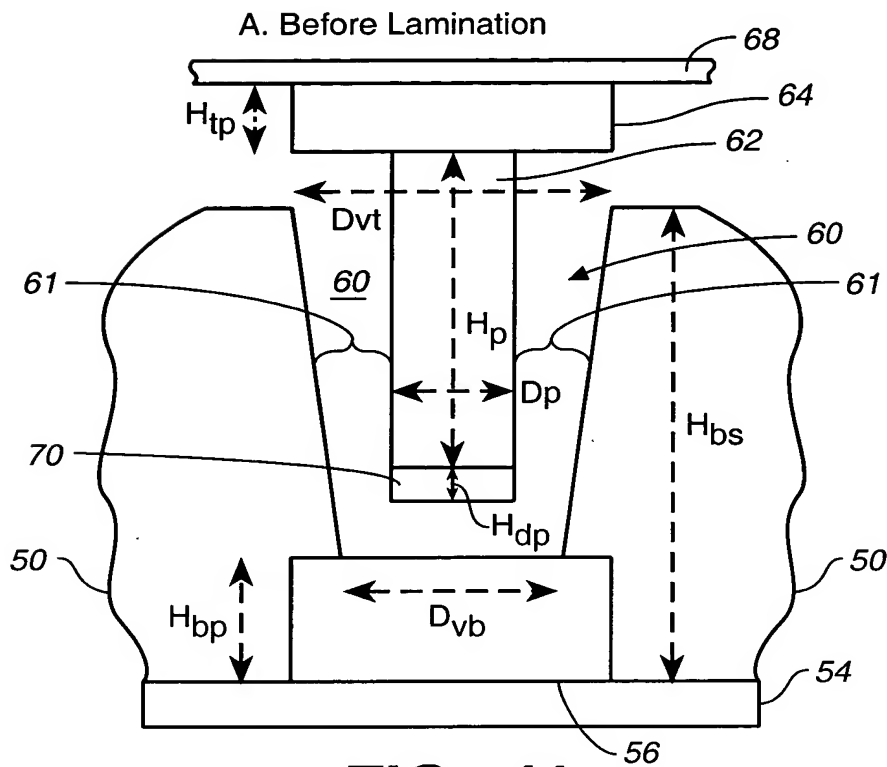
FIG._10

6. Process Flow

Lamination



The Concept



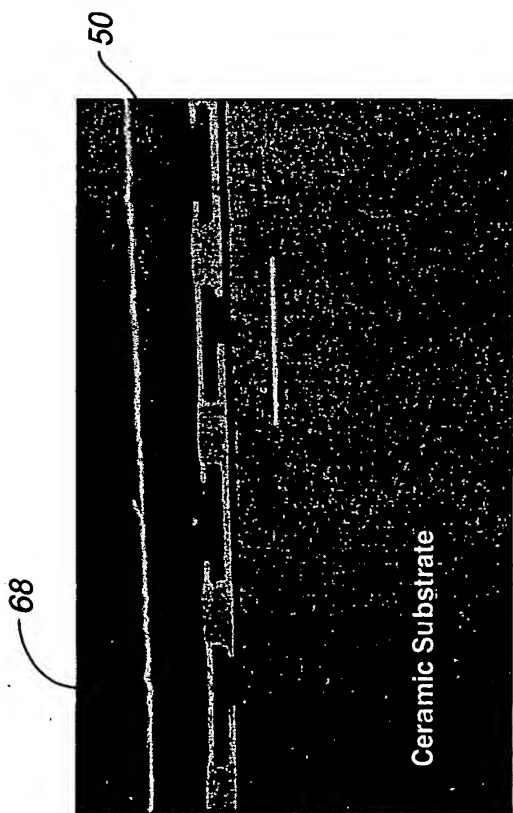


FIG. 13

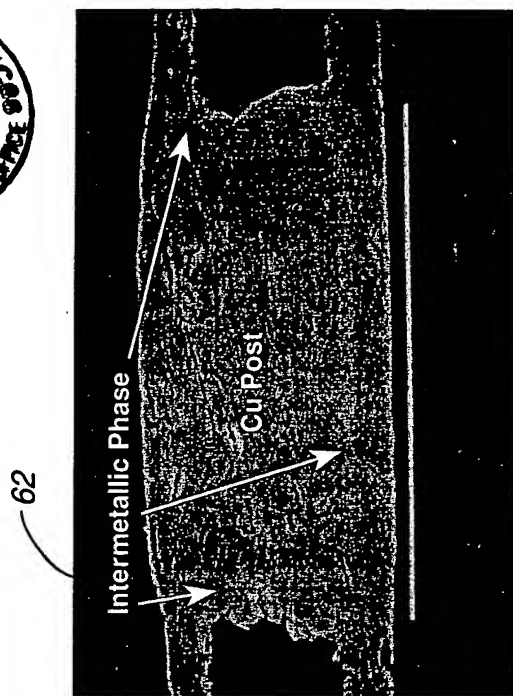


FIG. 14

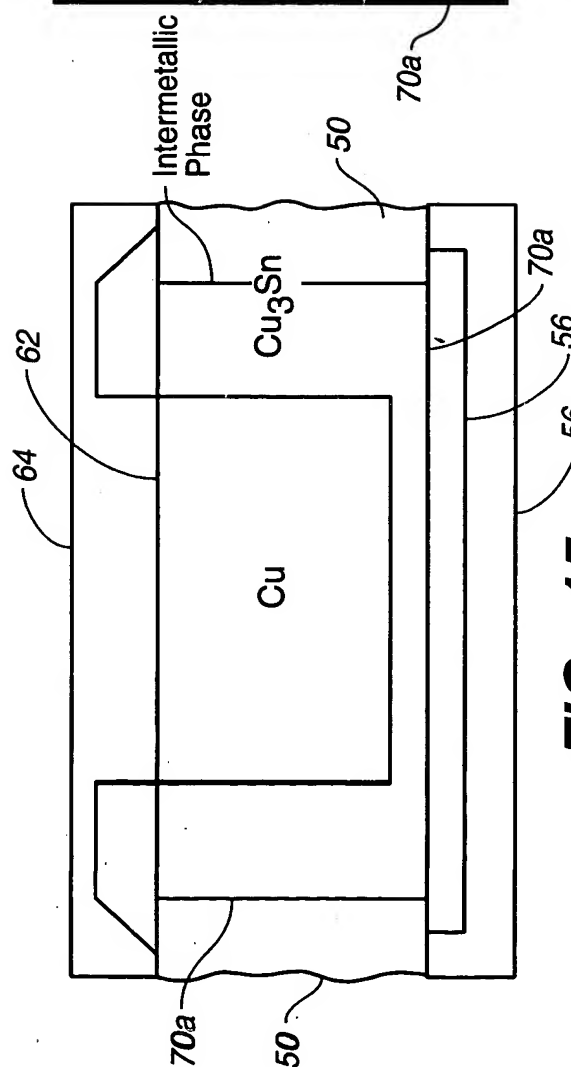


FIG. 15

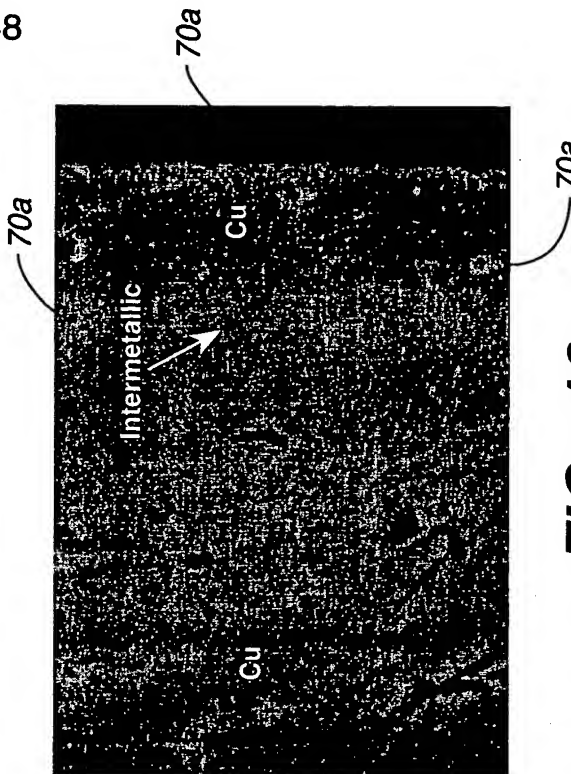


FIG. 16



FIG._17

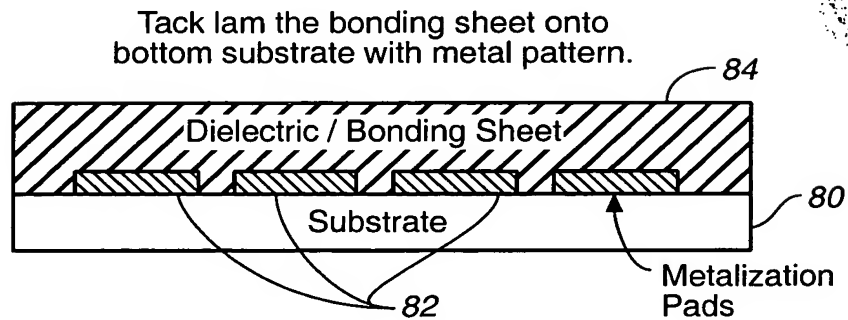


FIG._18

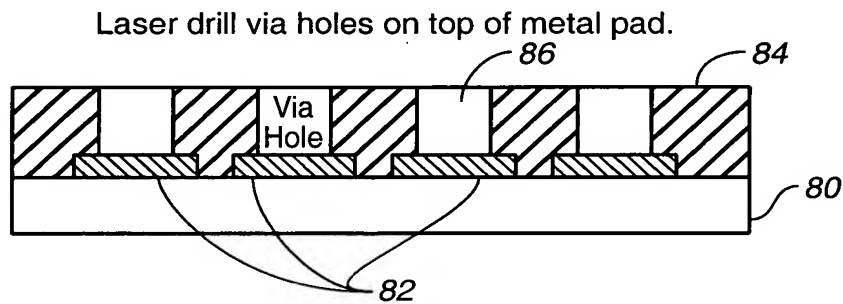


FIG._19

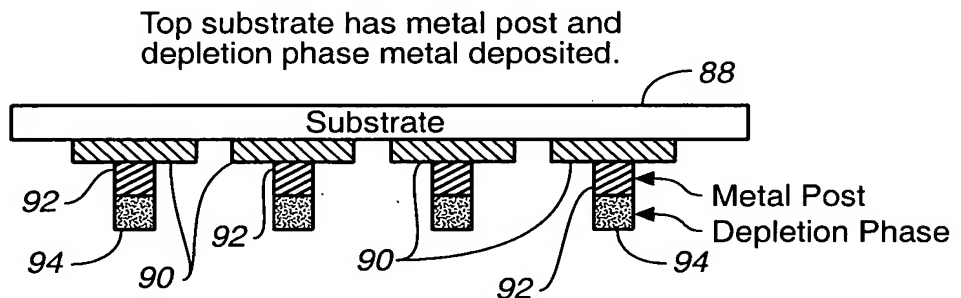
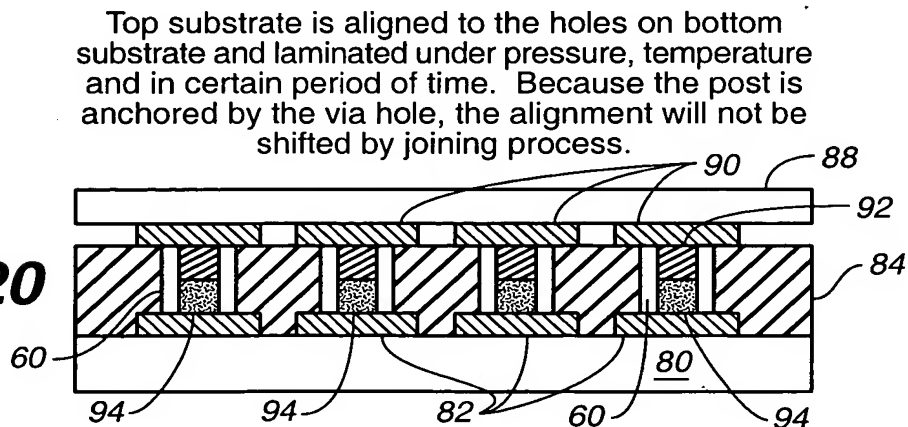


FIG._20





After lamination at suitable temperature for both bonding sheet and Transient Liquid Alloy Joints, the final structure has a filled via with metal post embedded inside intermetallic wall.

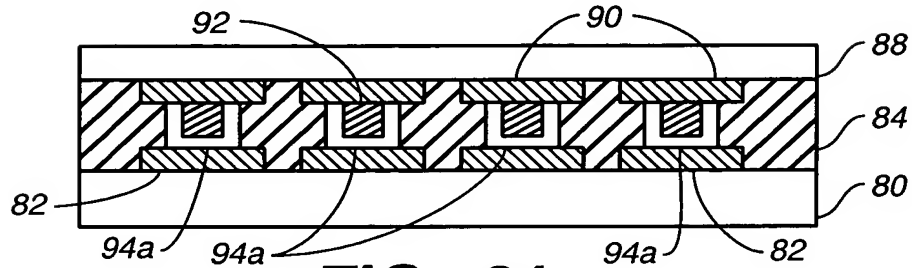


FIG. 21

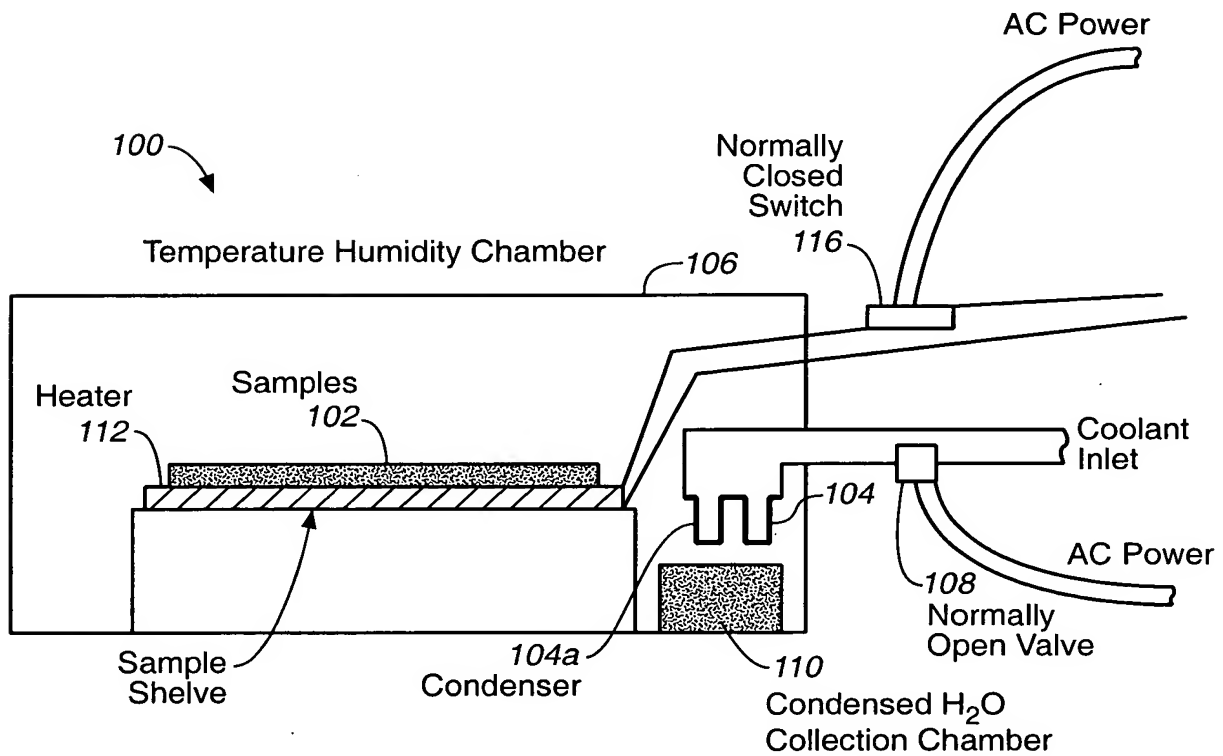


FIG. 22



FIG._23

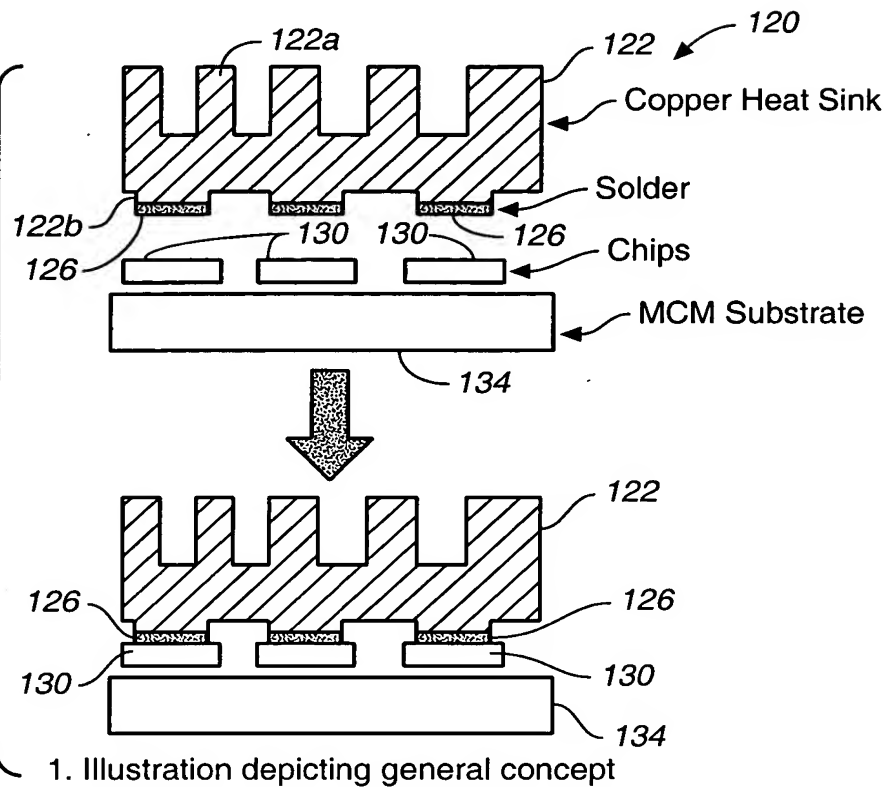


FIG._24

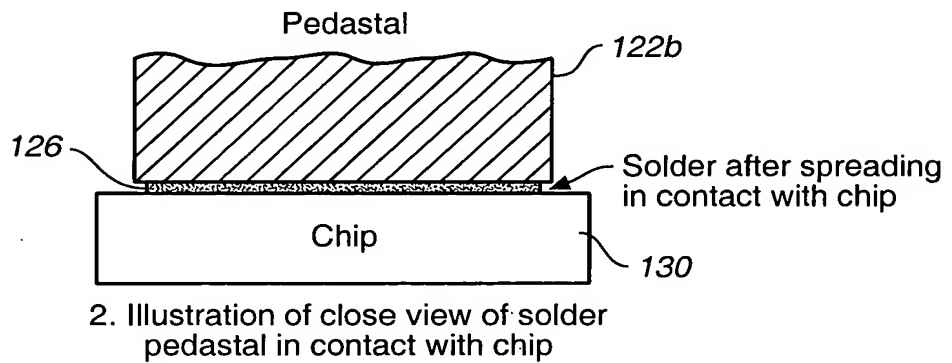
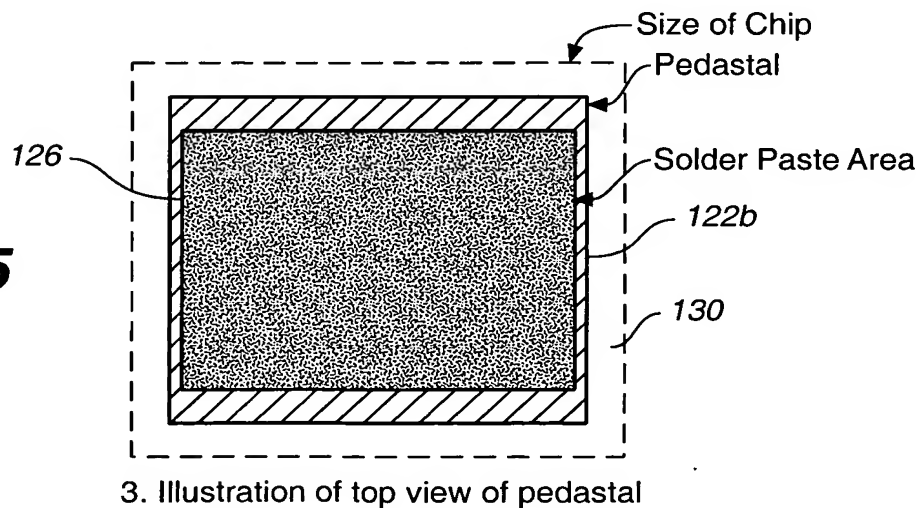


FIG._25



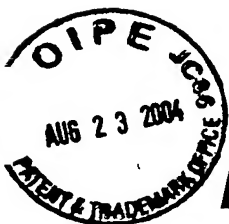


FIG._26
(PRIOR ART)

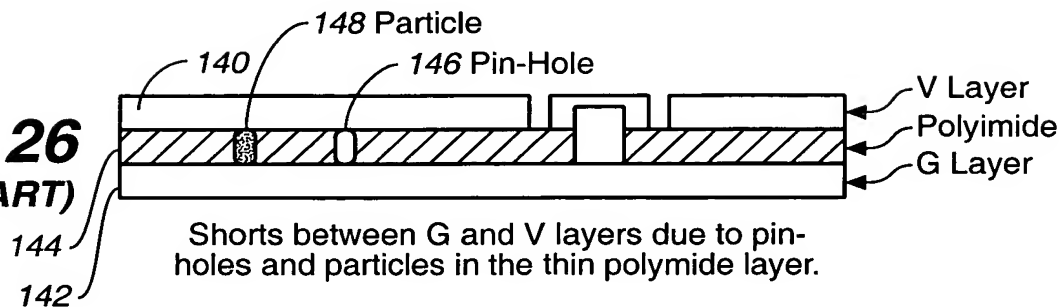


FIG._27

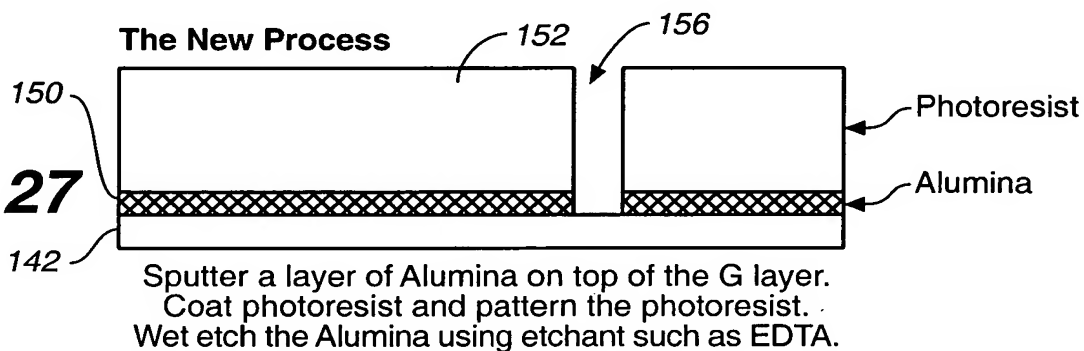


FIG._28

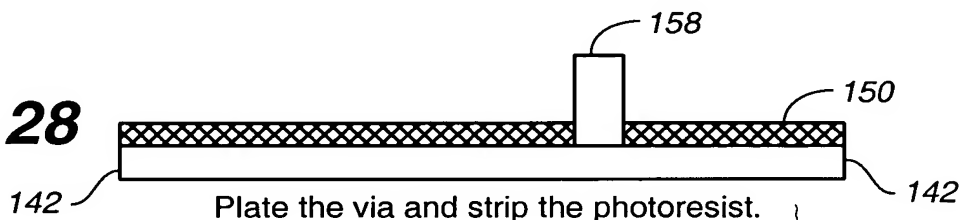


FIG._29

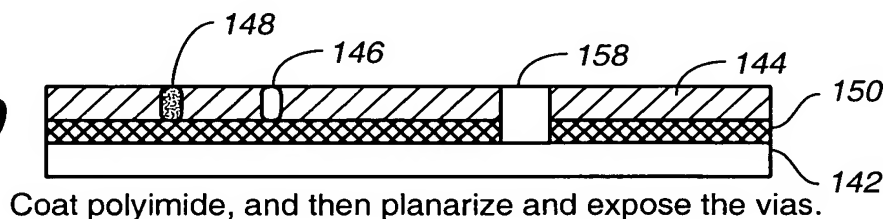


FIG._30

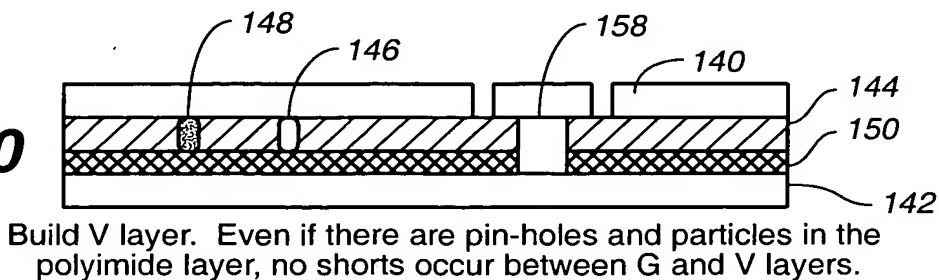


FIG._31

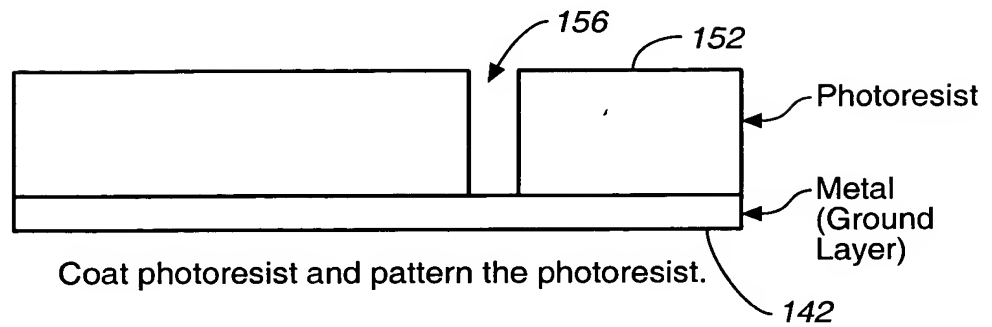


FIG._32

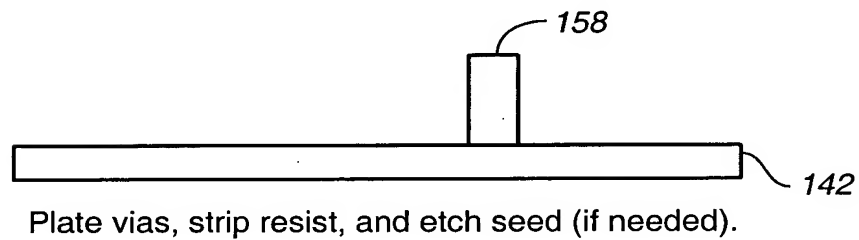


FIG._33

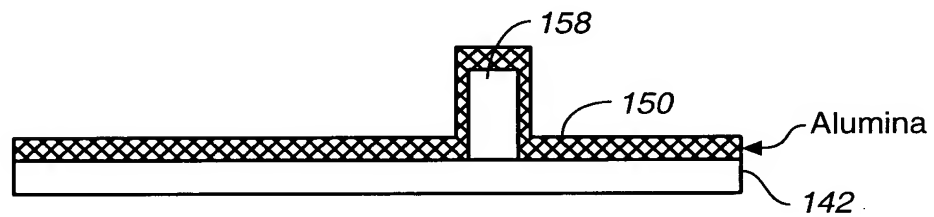


FIG._34

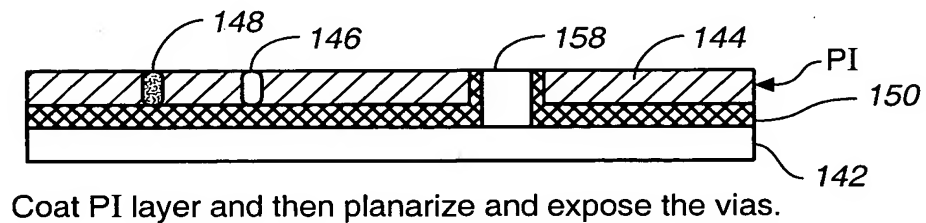
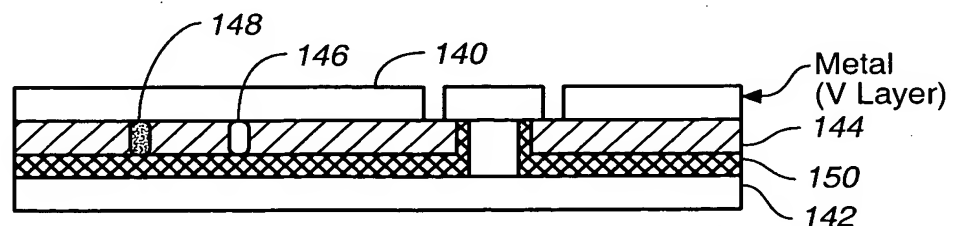


FIG._35



Coat a polyimide layer on top of a substrate. The substrate may be pre-treated for later film / substrate separation. Sputter Cr-Cu seed, and build up multi-layer circuits. The Cr-Cu seed layer is not removed until the film / substrate separation.

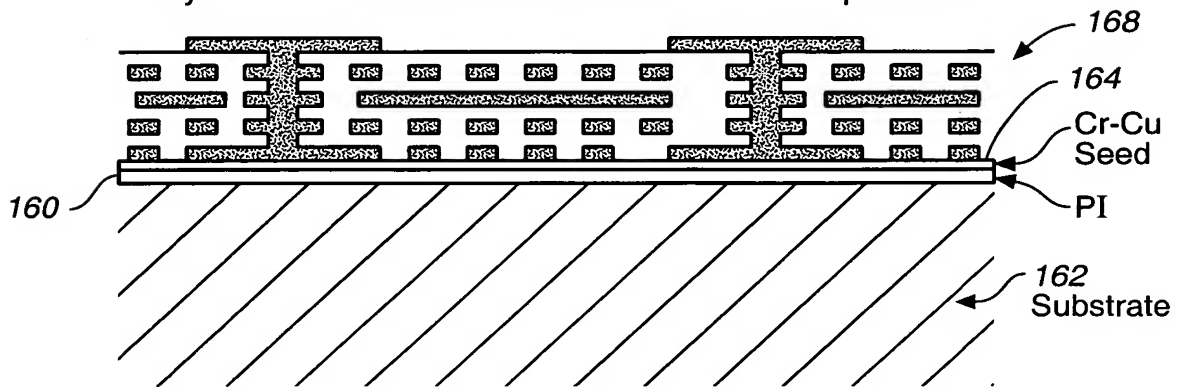


FIG. 36

After film / substrate separation.

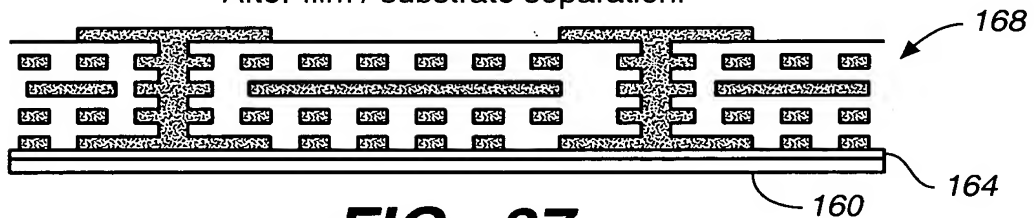


FIG. 37

The polyimide layer is etched away using oxygen plasma. The Cr-Cu seed layer serves as the stop-layer for the plasma etching.

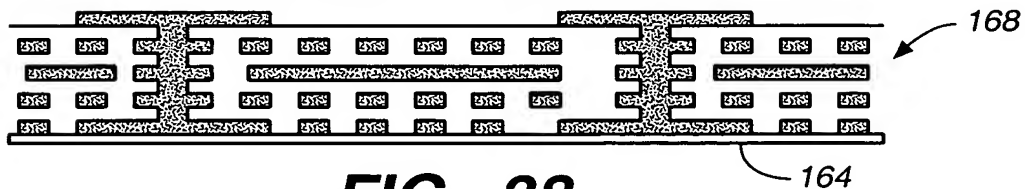


FIG. 38

After wet etch of Cr-Cu seed.

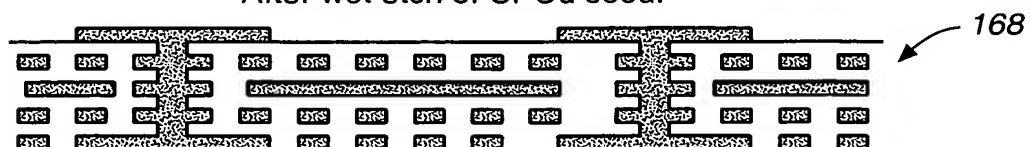


FIG. 39

Coat a polyimide layer on top of a substrate and sputter Cr-Cu seed on top of the polyimide. The substrate may be pre-treatment for later film / substrate separation. The seed is etched away after completing the first metal pattern layer. Multi-layer circuits are then built.

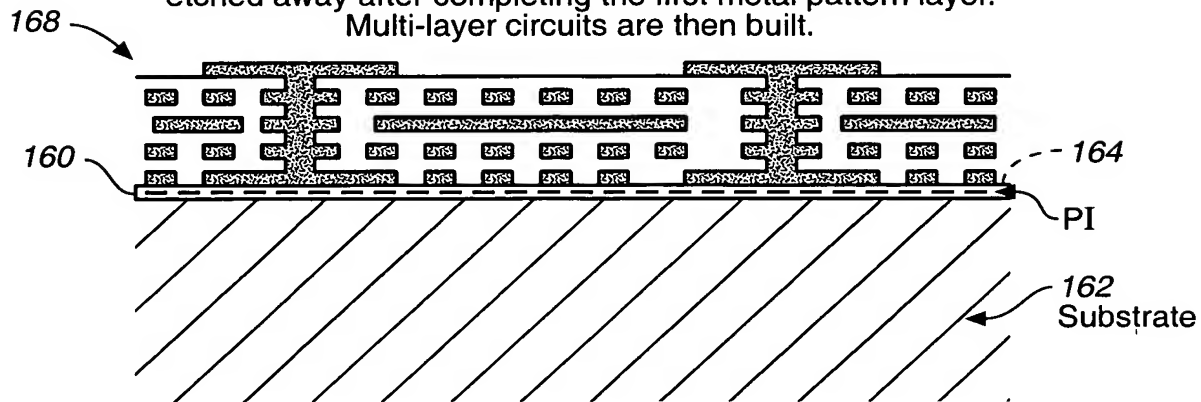


FIG. 40

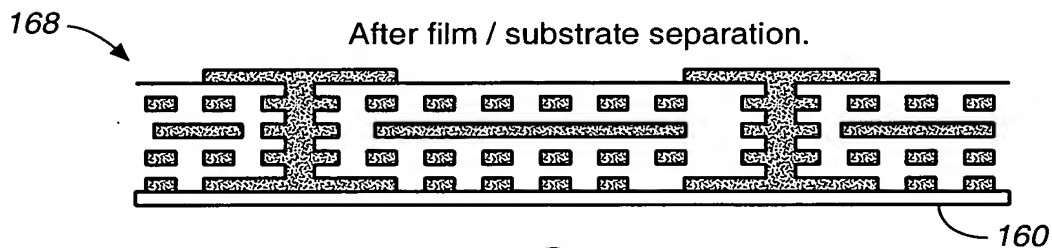


FIG. 41

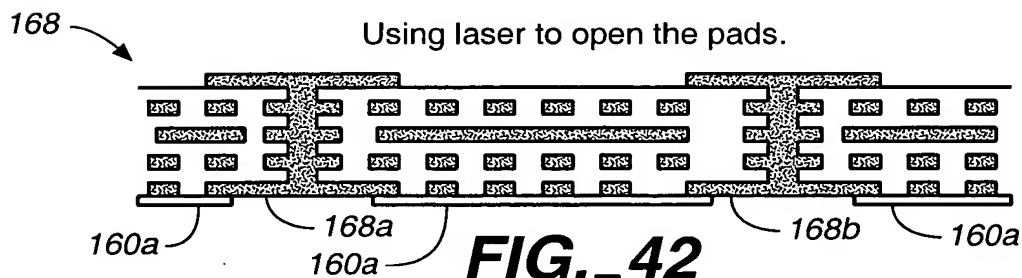


FIG. 42

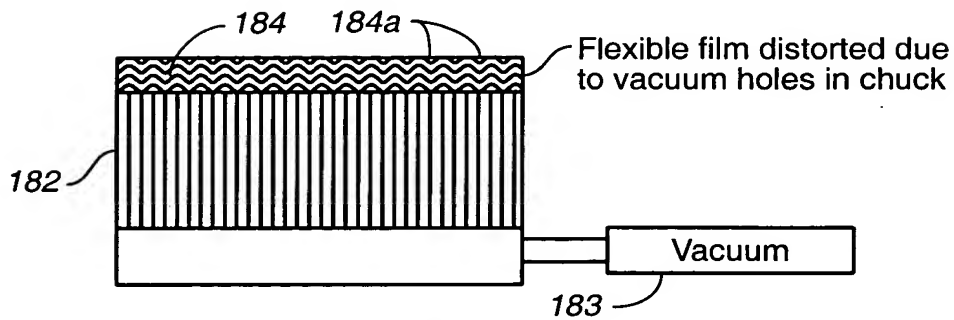


FIG._43

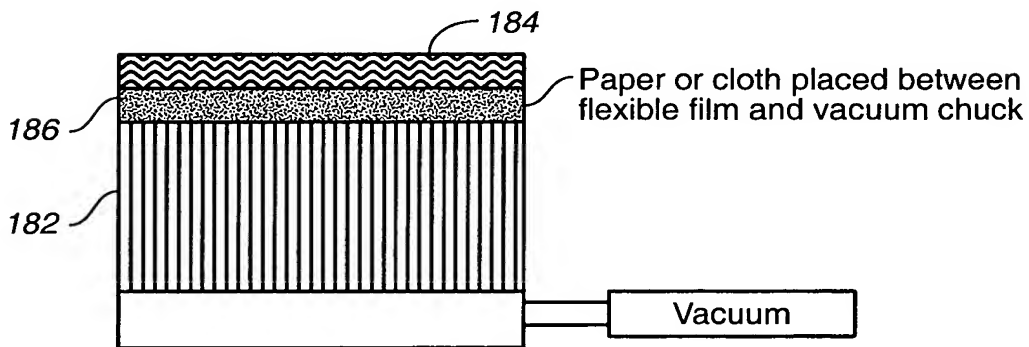
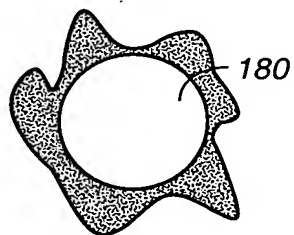
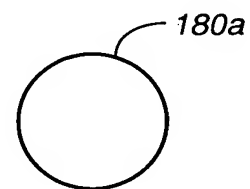


FIG._44



Bottom burn from
laser ablation

FIG._45



Burn reduced when
paper or cloth is used

FIG._46

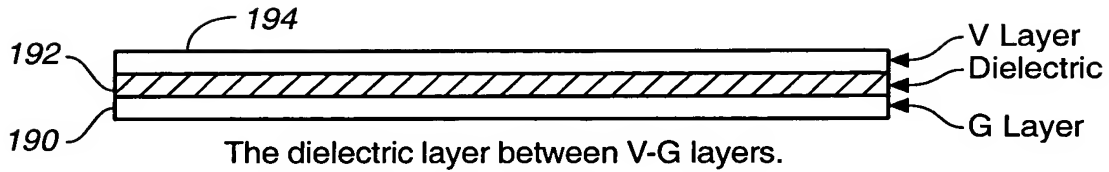


FIG. 47

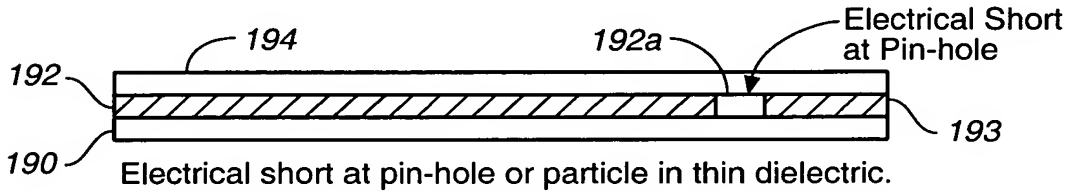


FIG. 48

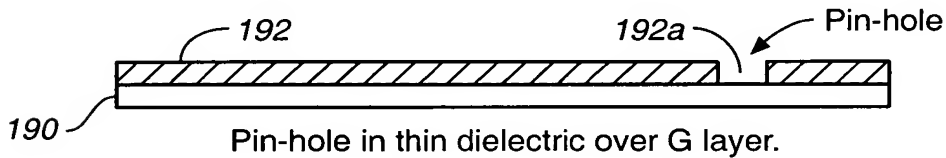


FIG. 49

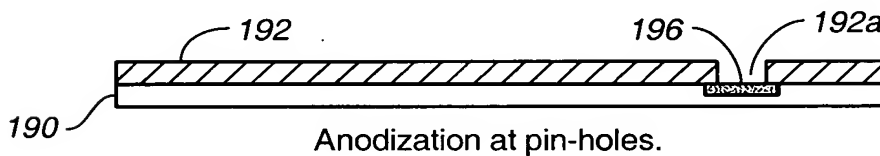


FIG. 50

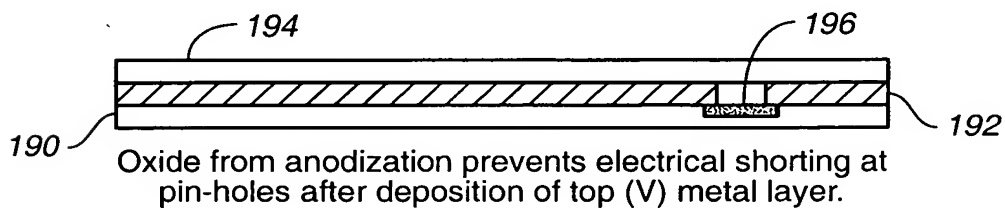


FIG. 51

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FIG._52A

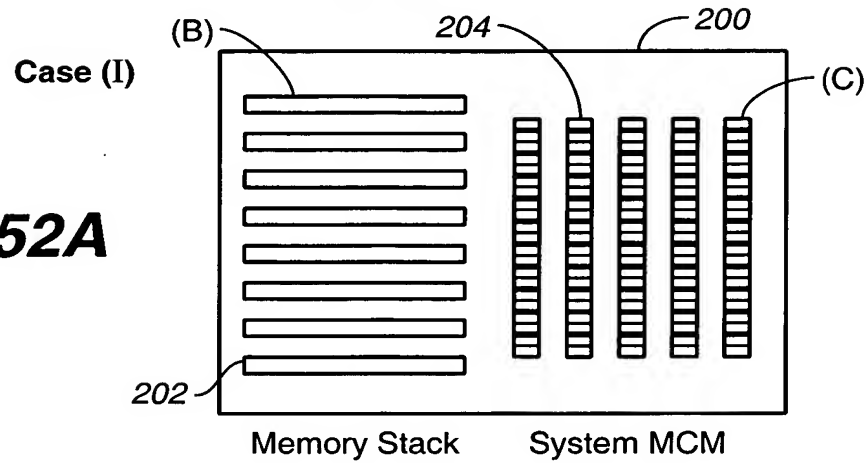


FIG._52B

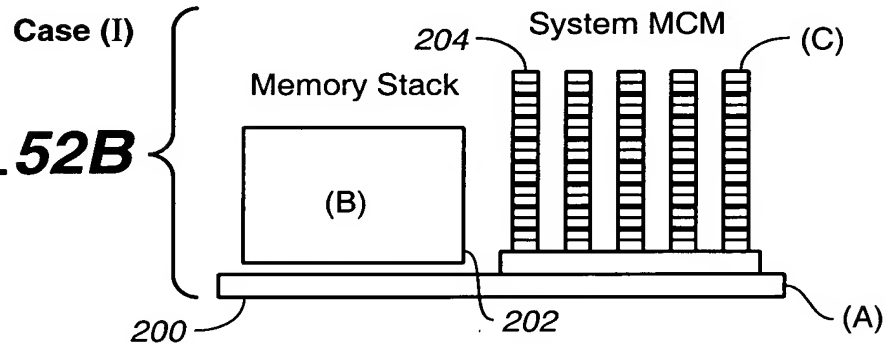


FIG._53A

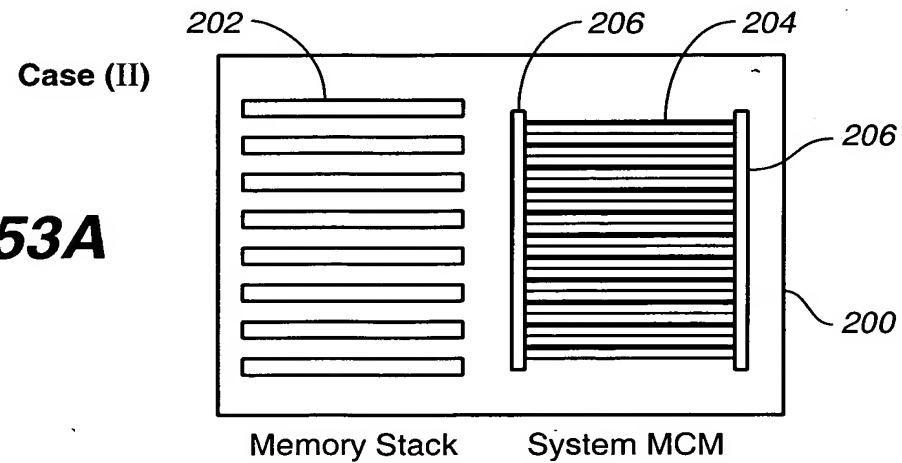
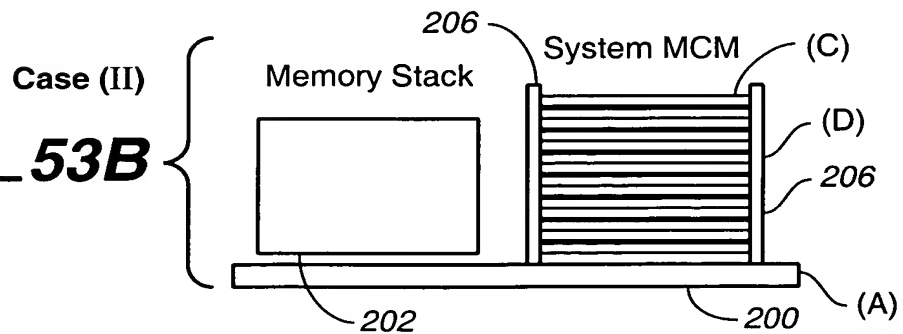


FIG._53B



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FIG._54A

Case (III)

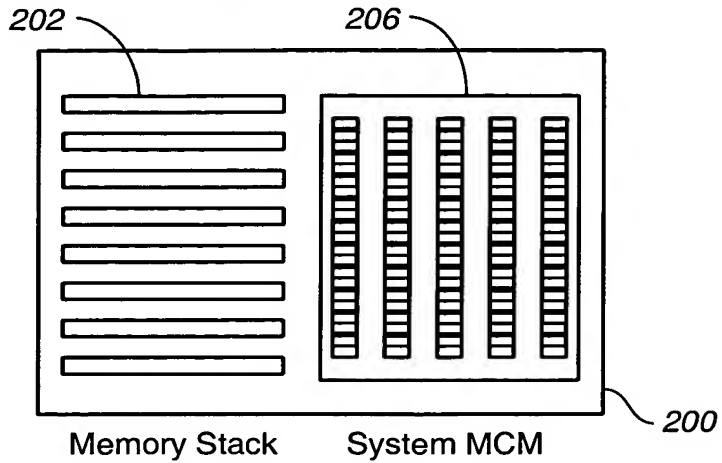


FIG._54B

Case (III)

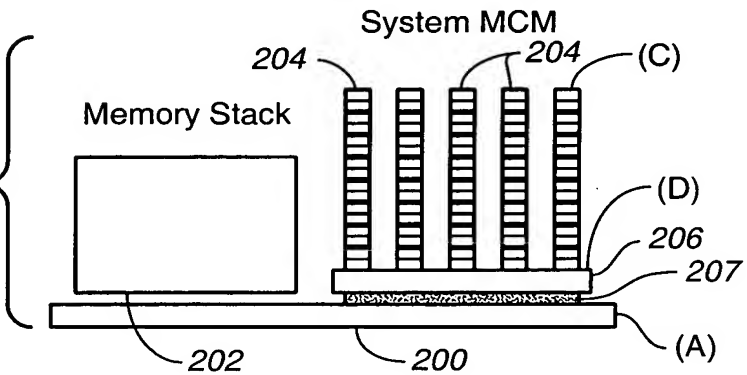


FIG._55A

Case (IV)

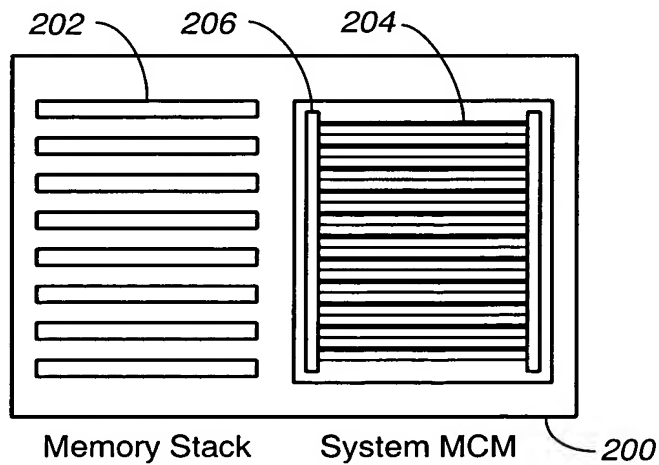
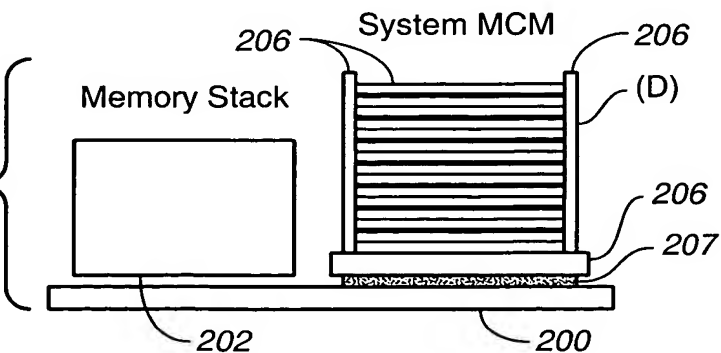
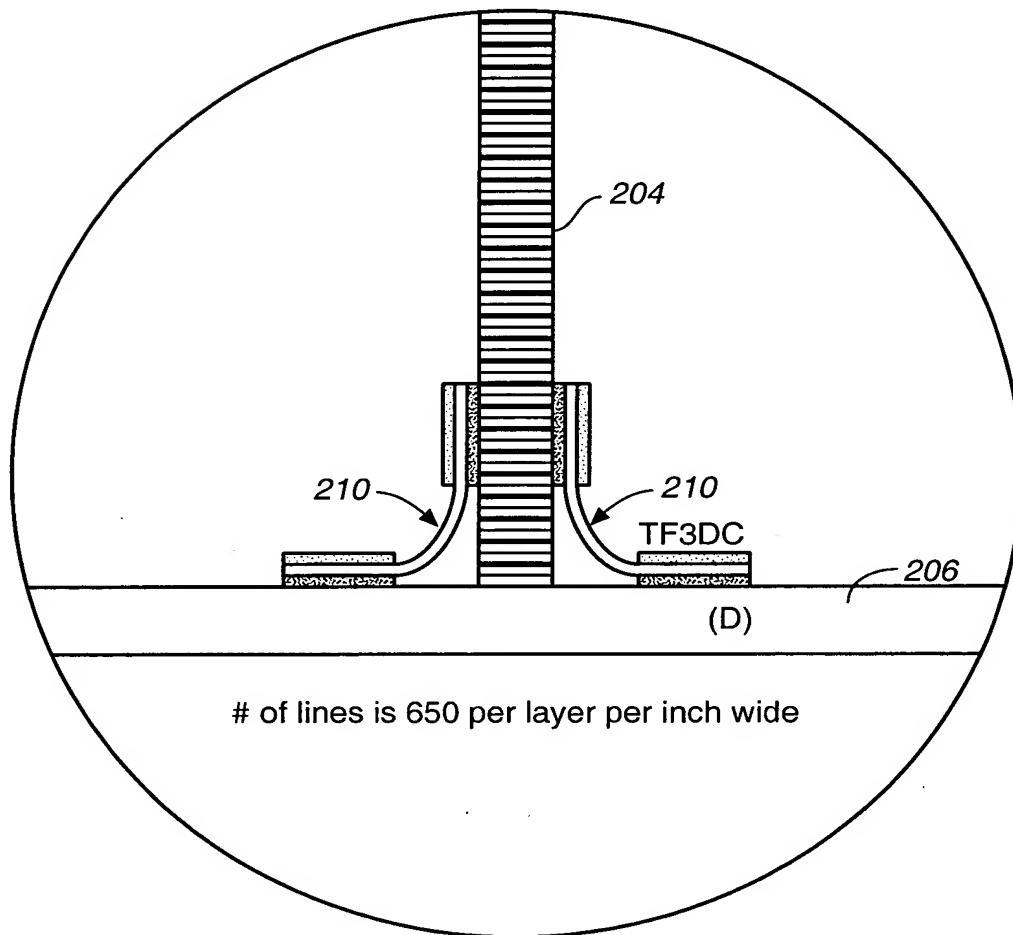
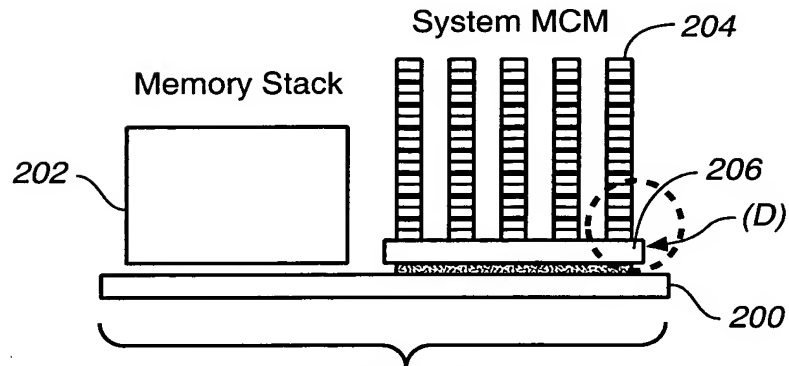
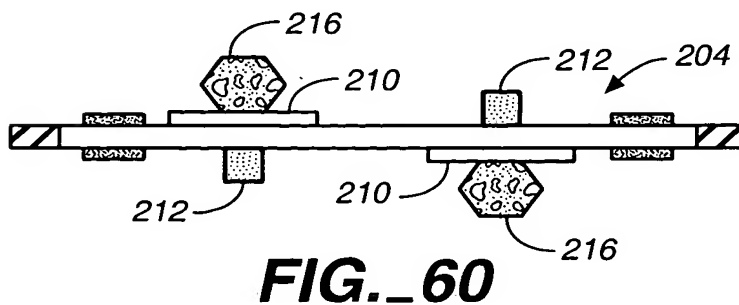
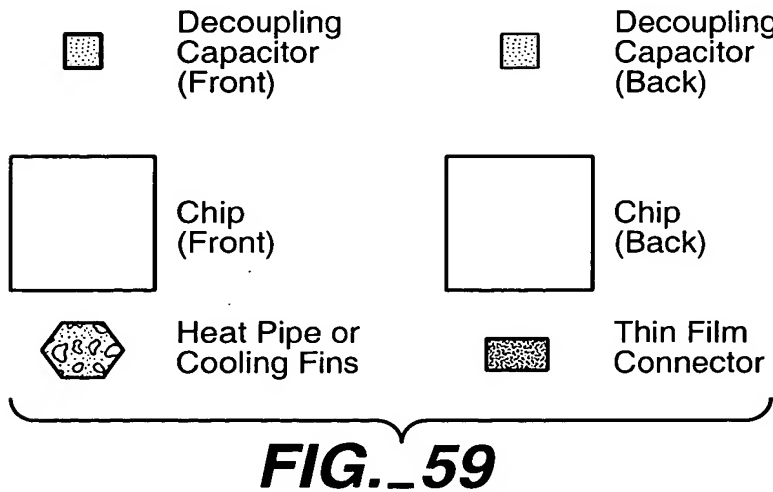
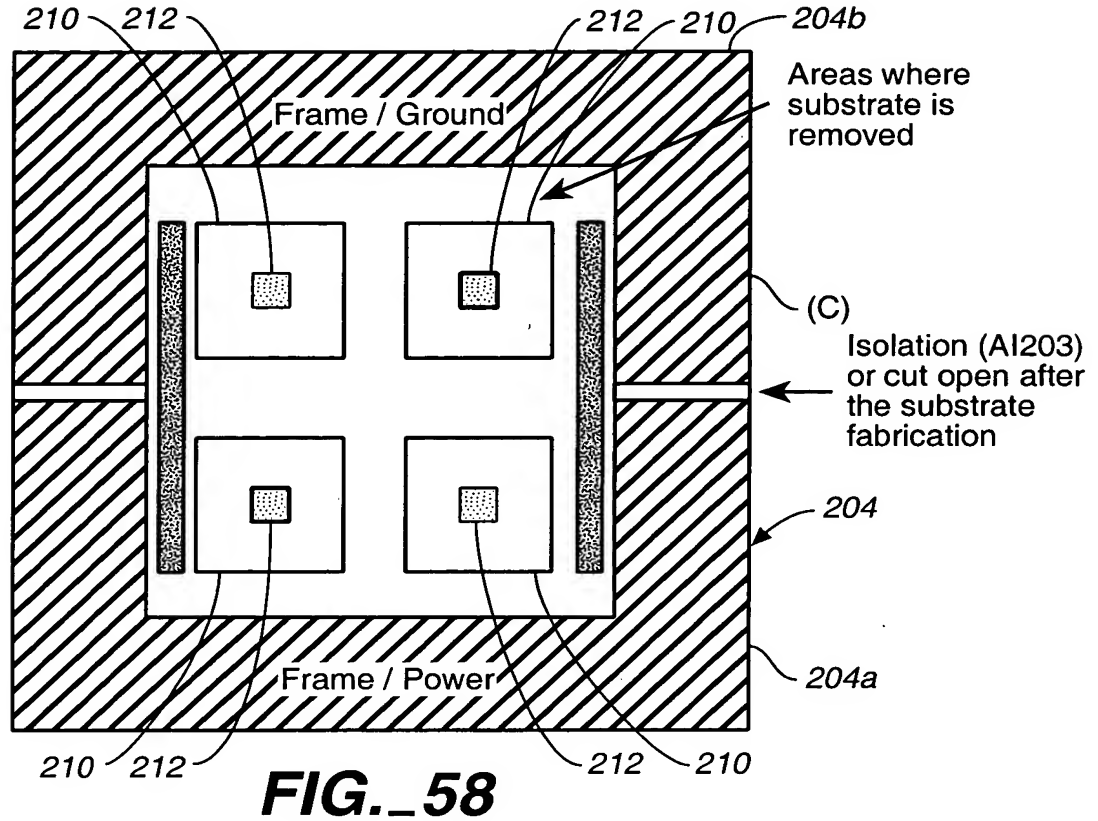


FIG._55B

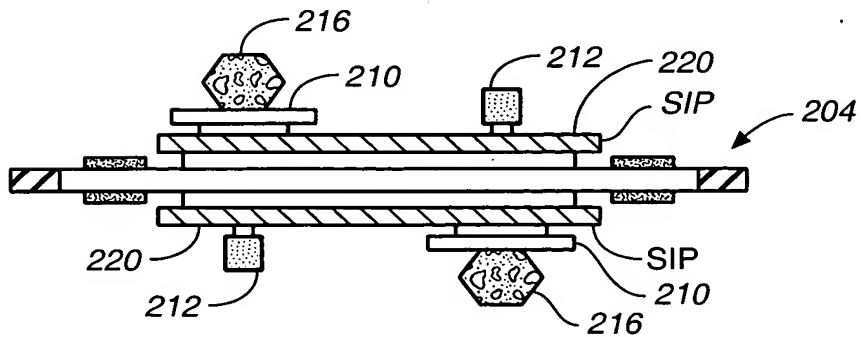
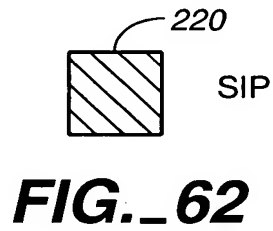
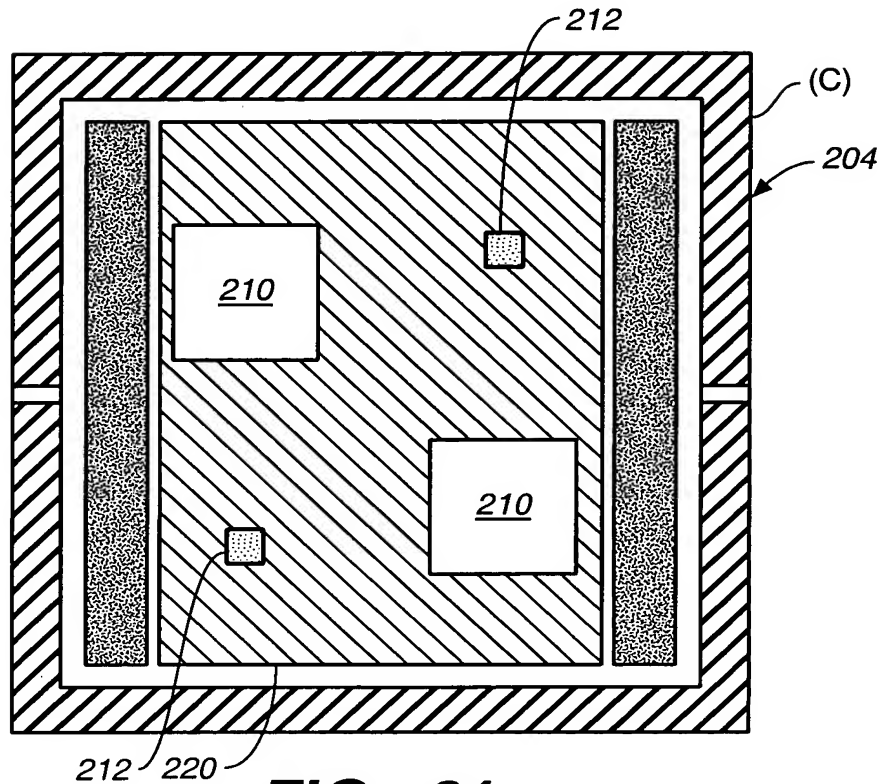
Case (IV)

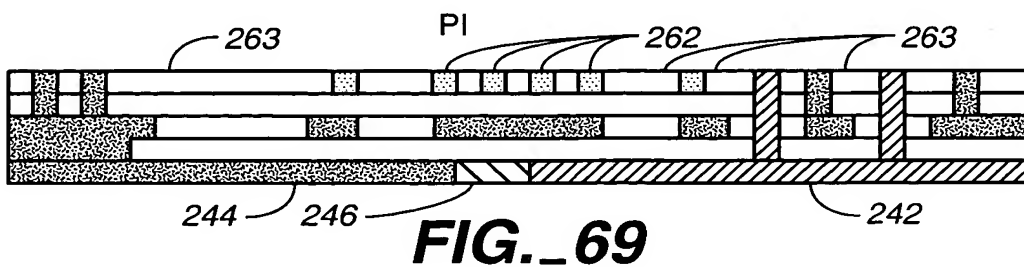
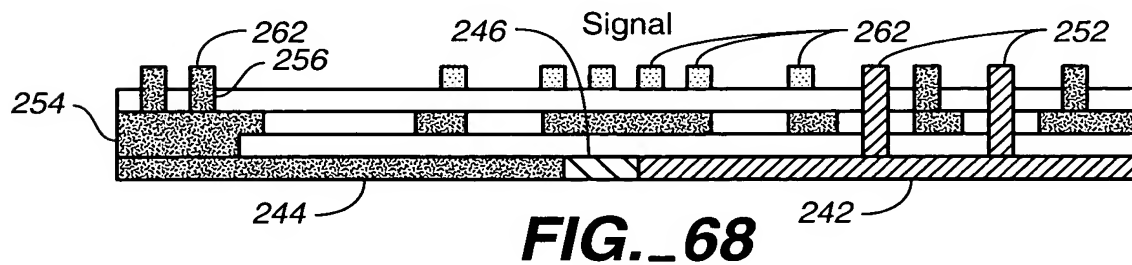
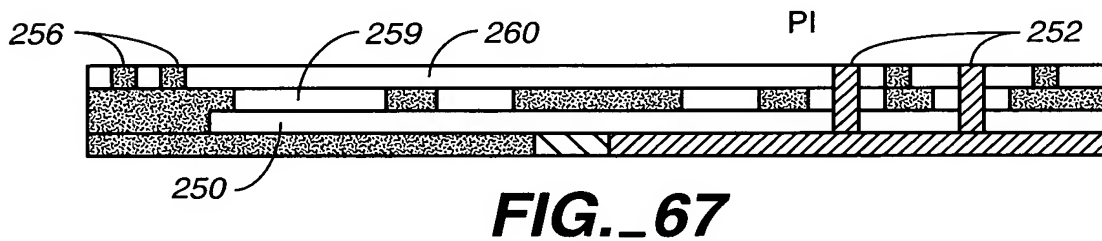
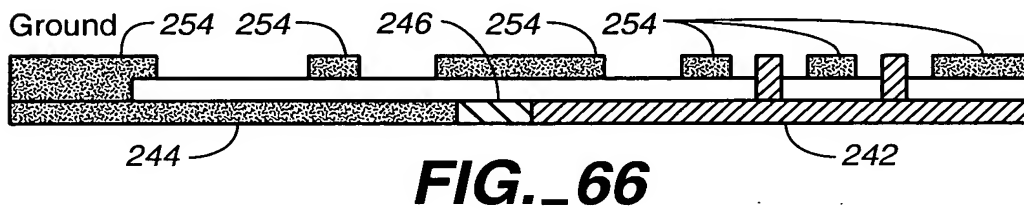
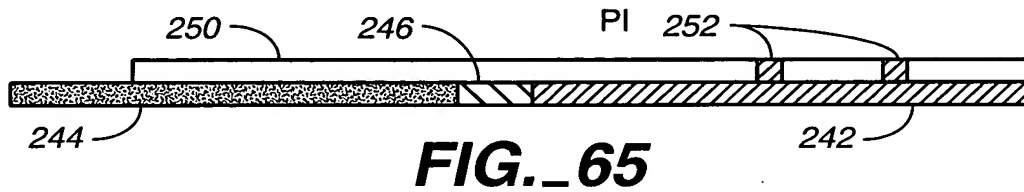
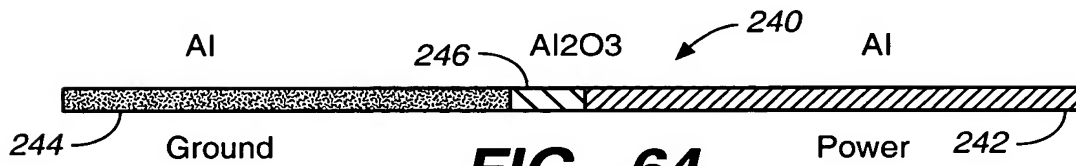






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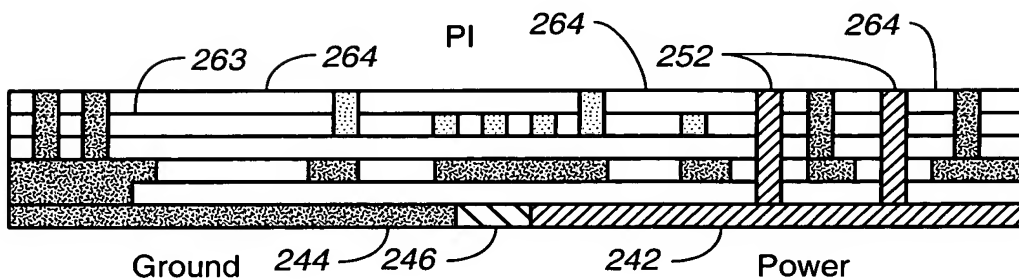


FIG._70

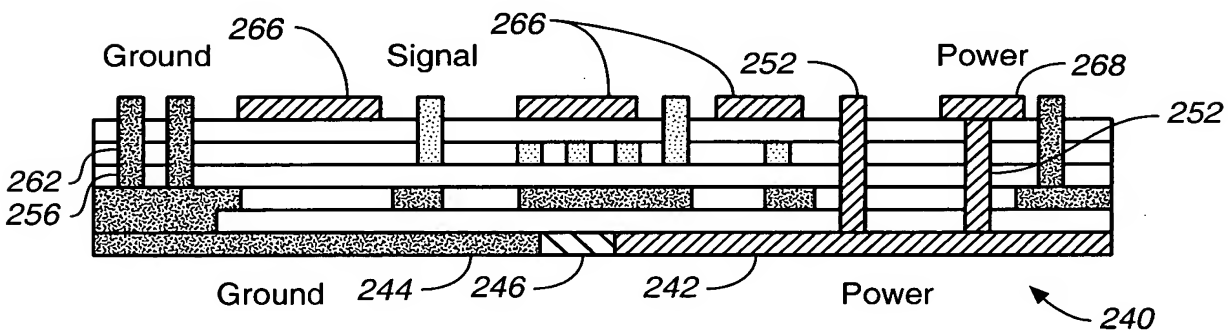


FIG._71

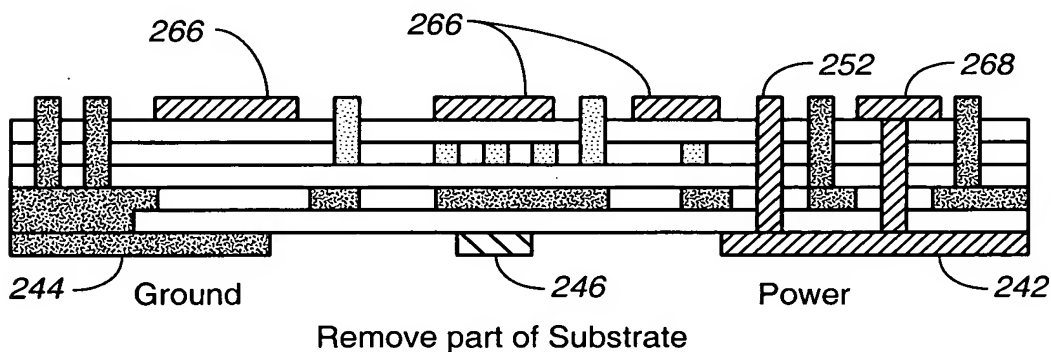


FIG._72

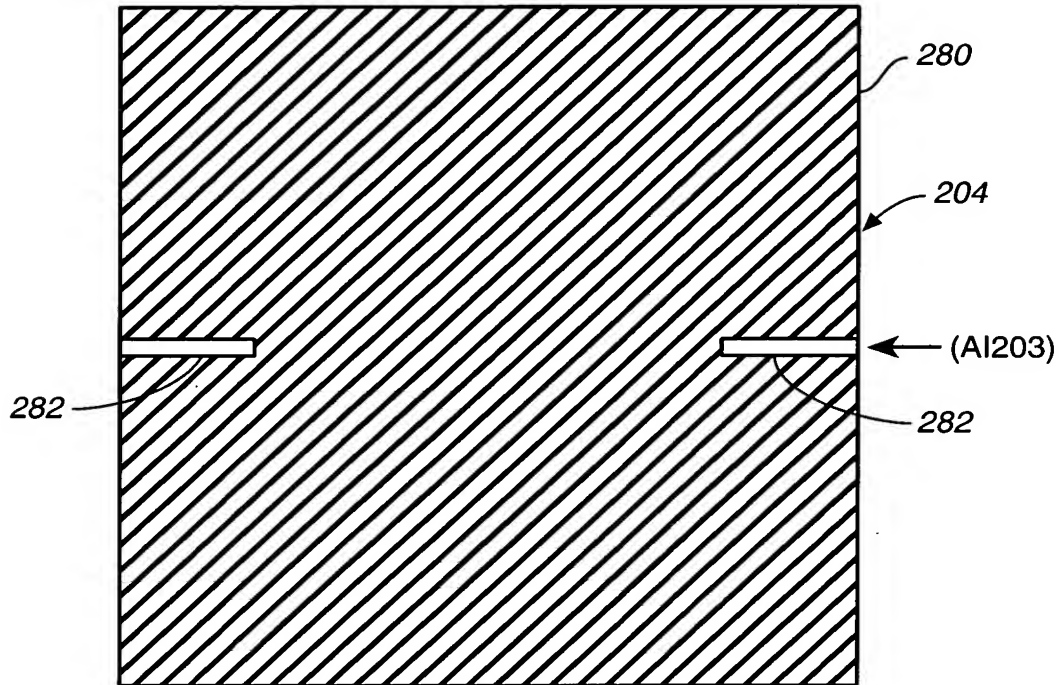


FIG. 73

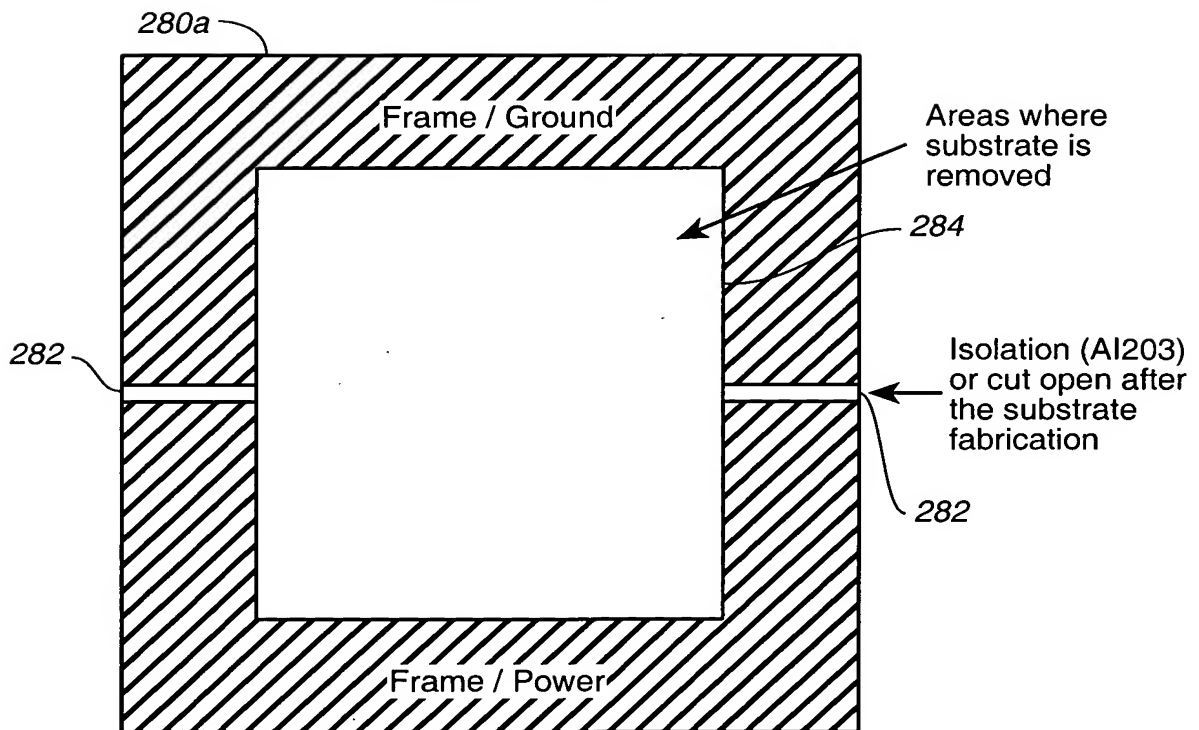


FIG. 74



FIG. 75

FIG._76

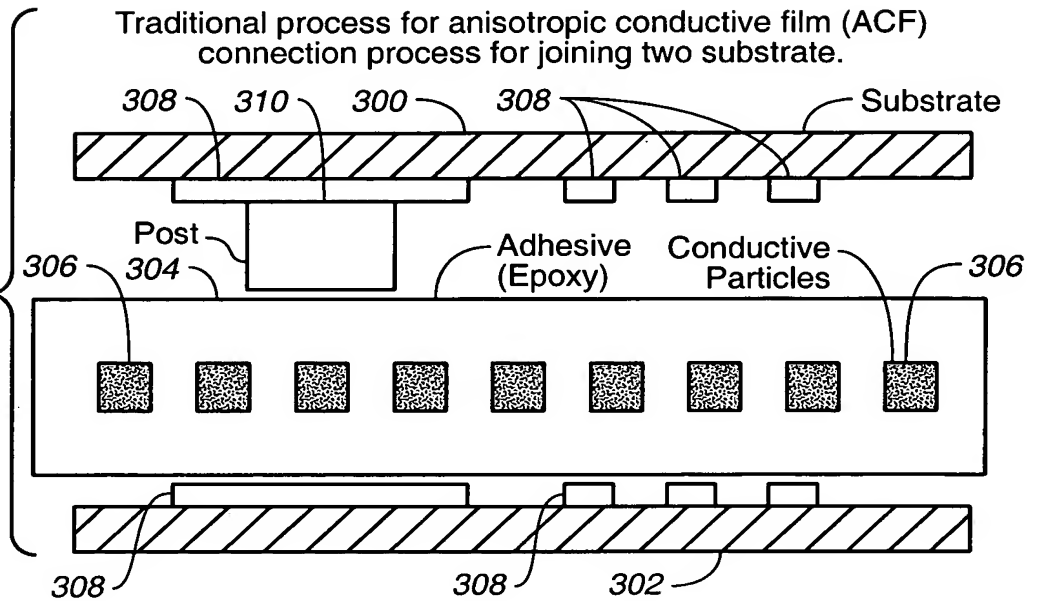


FIG._77

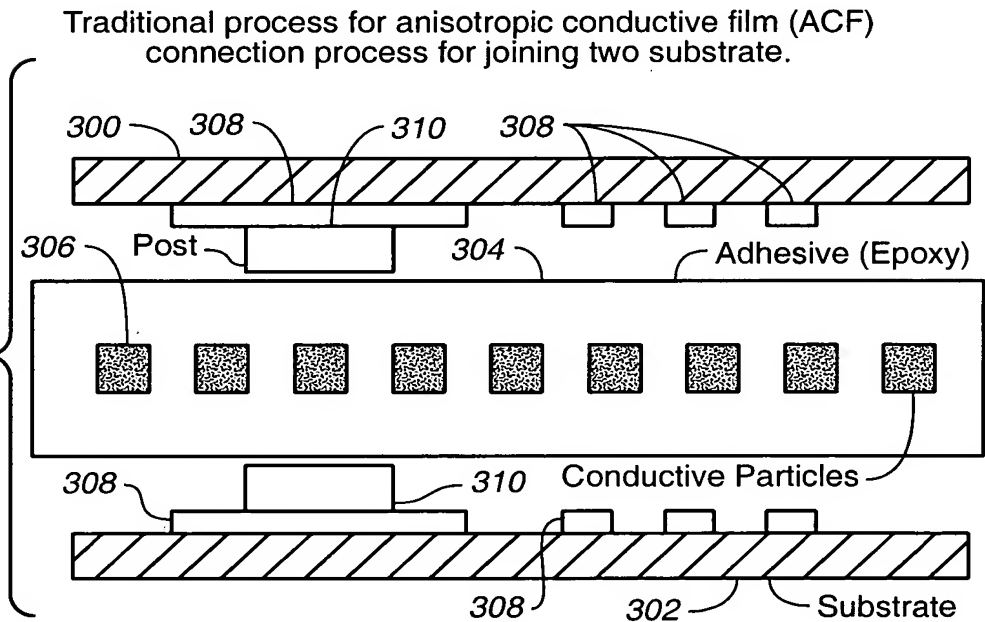


FIG._78

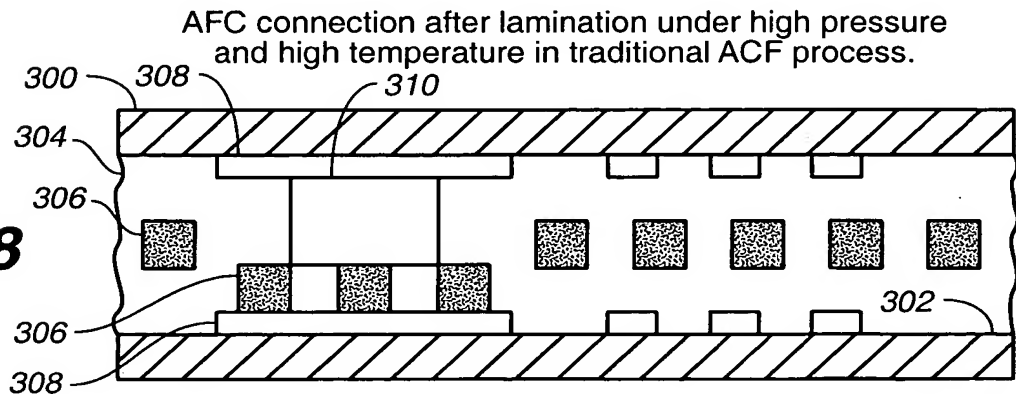


FIG._79

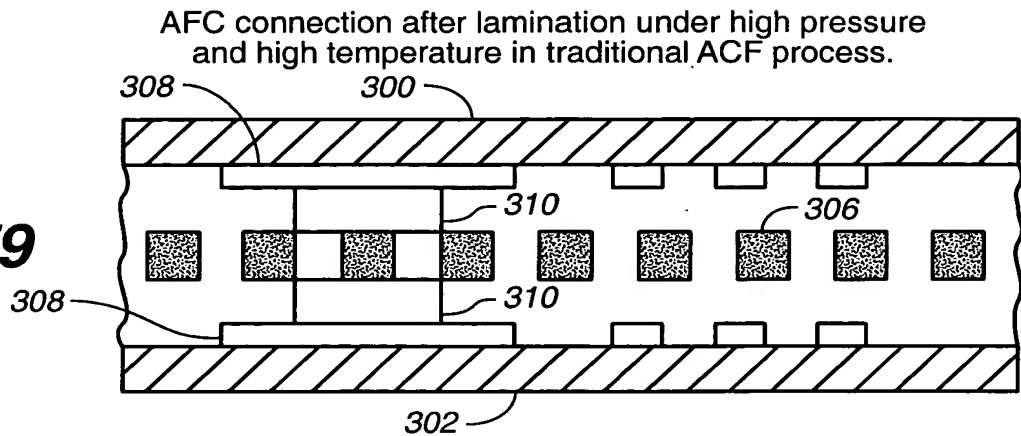


FIG._80

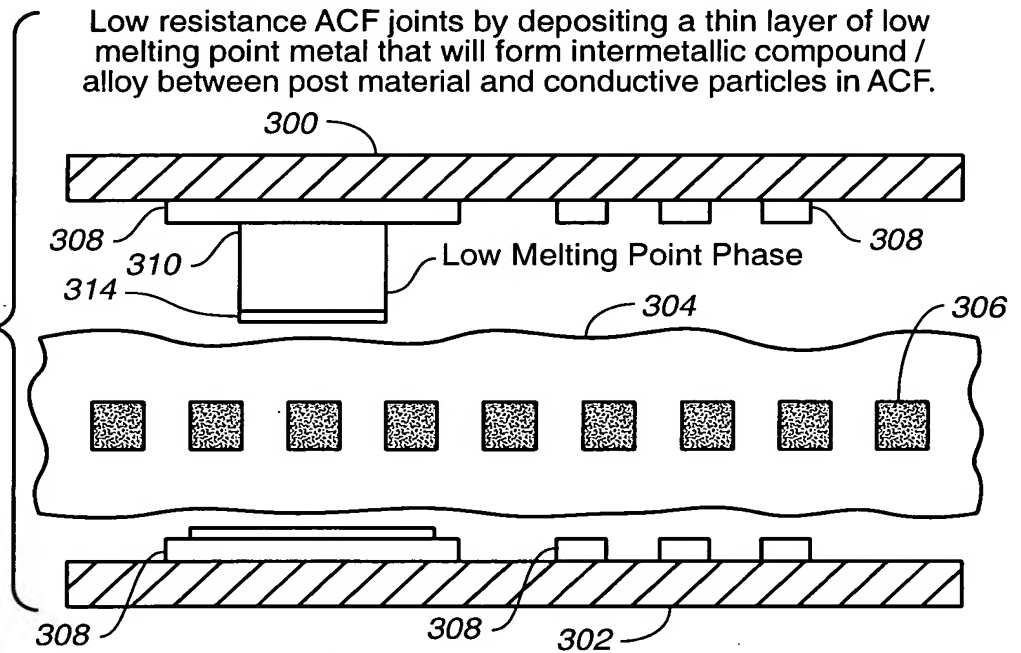
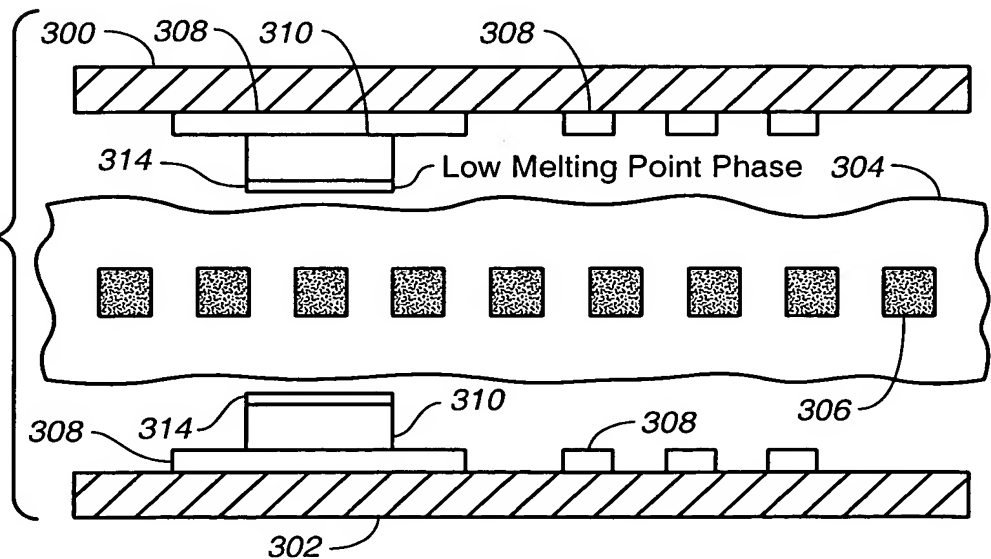


FIG._81



After joining process (high pressure and high temperature),
intermetallic / alloy formed at the interface of post and
conductive particles. The intermetallic / alloy will decrease
the contact resistance from traditional ACF process and
provide a stronger mechanical bond.

FIG._82

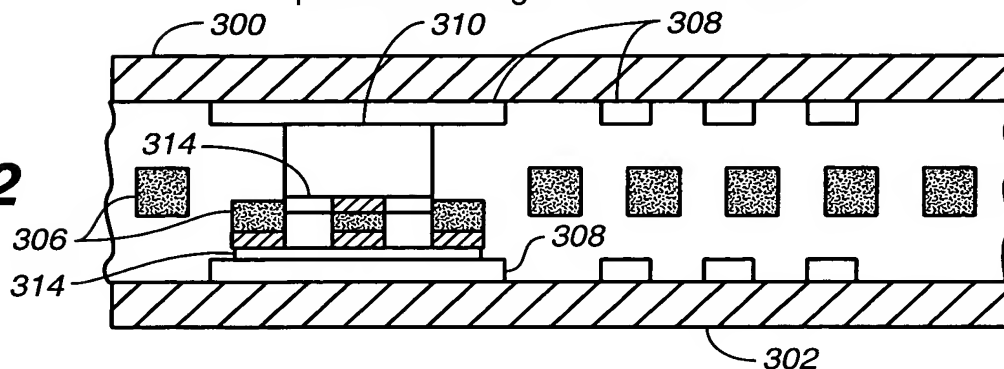
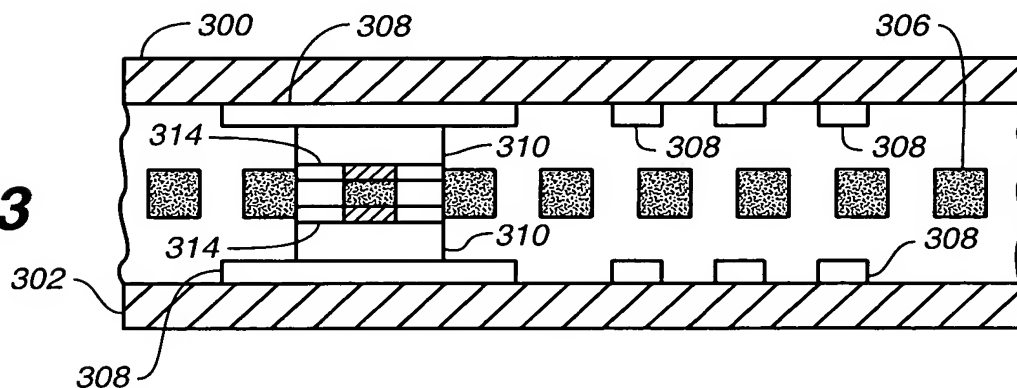
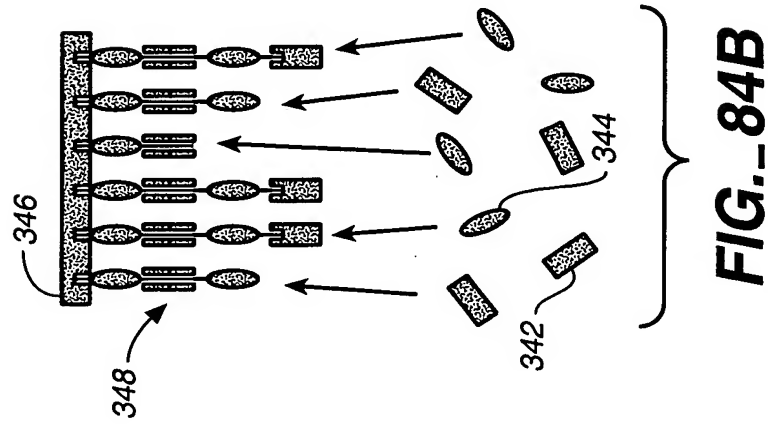
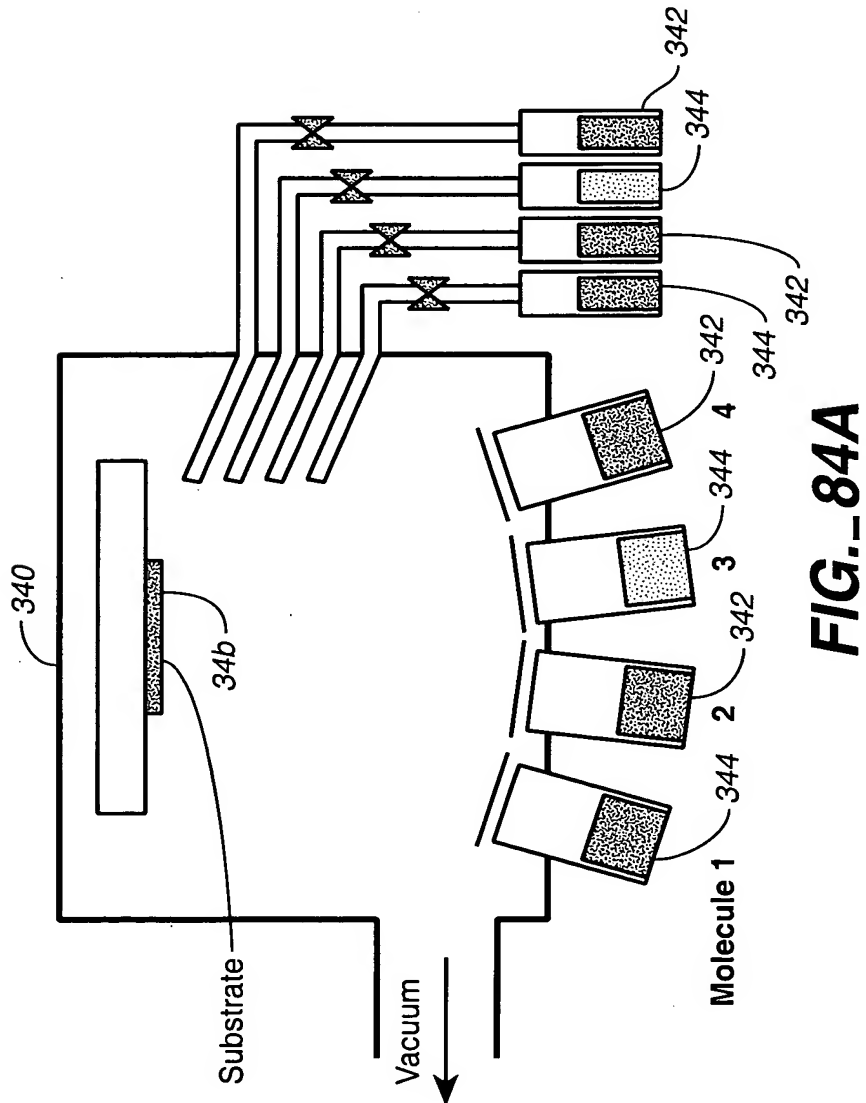
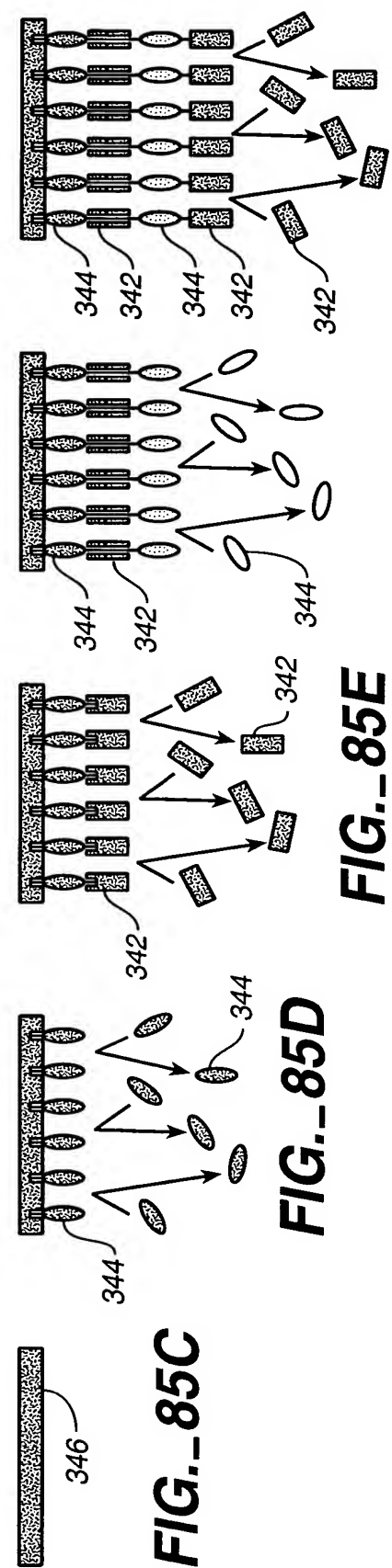
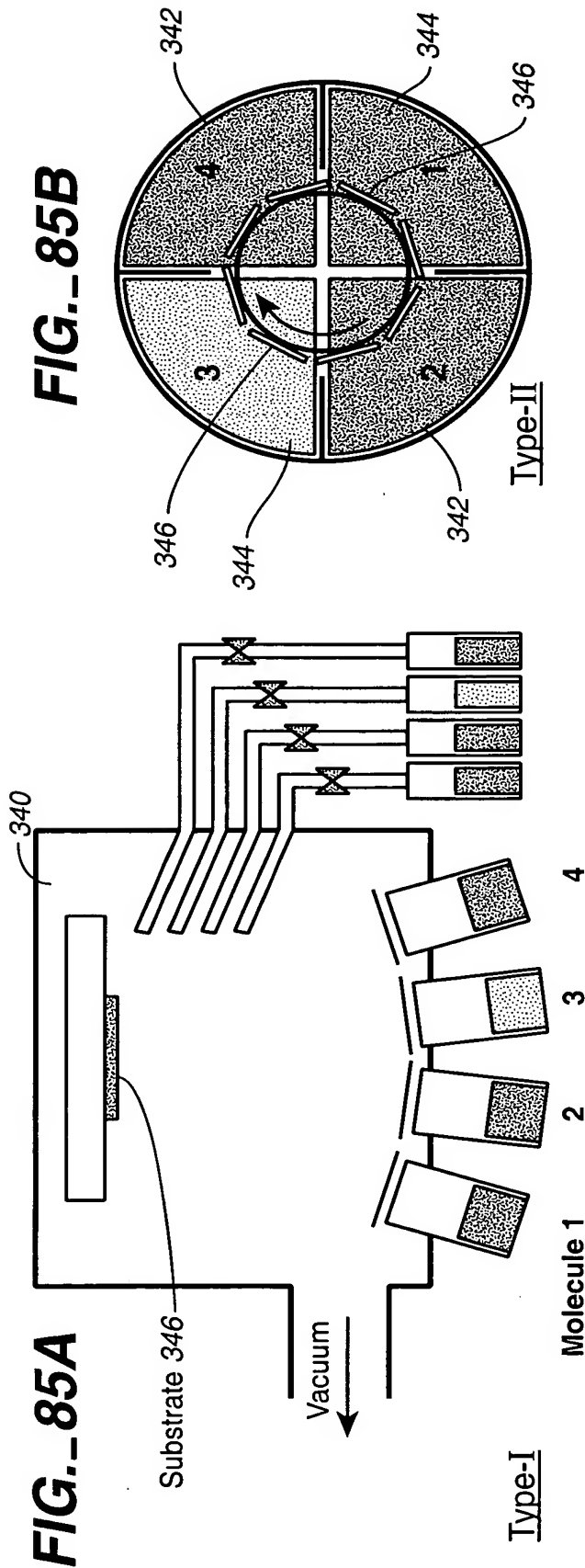


FIG._83







FUJITSU Computer Packaging Technologies, Inc.  FCPT

Vapor Phase Deposition Vs. Spin Coating

	Spin Coating	Vapor Phase Deposition	
		CVD	MLD
-Coverage Controllability	Low	High	High
-Thickness Accuracy / Uniformity	Low	Medium	High
-Deposition Rate	High	Medium	Low
<hr/>			
-Molecular-level Controllability	Low	Medium	High
-Selective / Deposition	No	Yes	Yes
-Selective Molecular Alignment	No	Yes	Yes

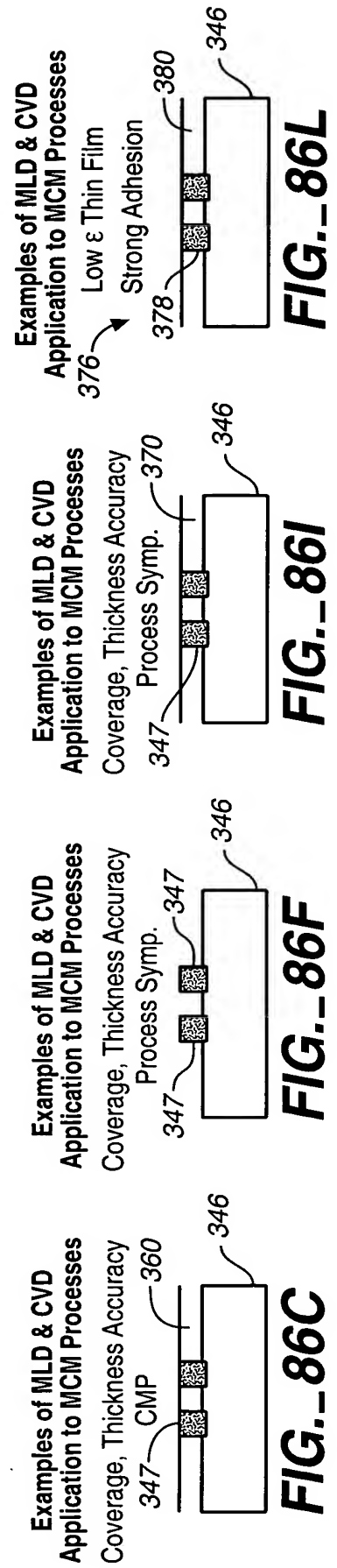
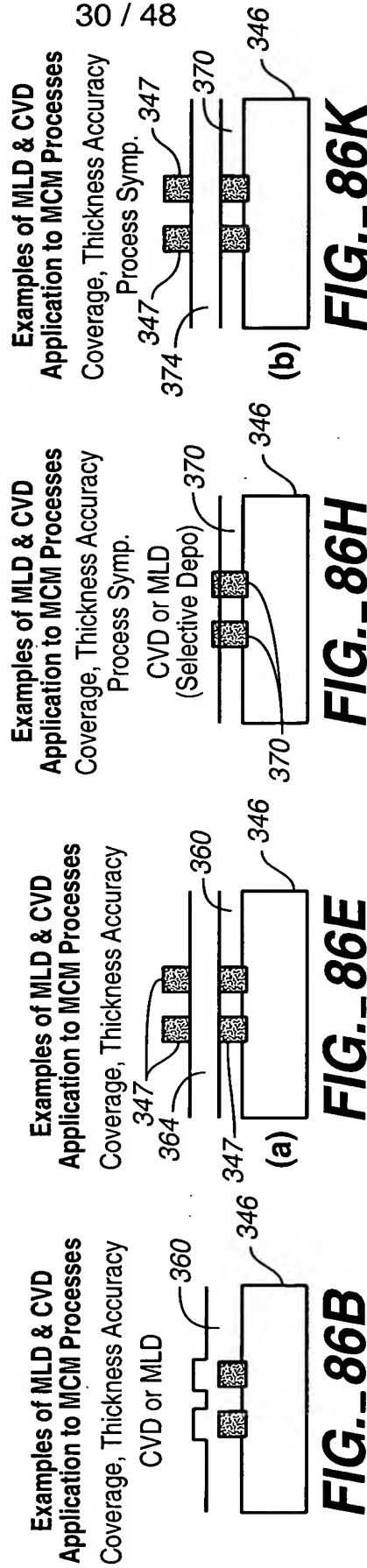
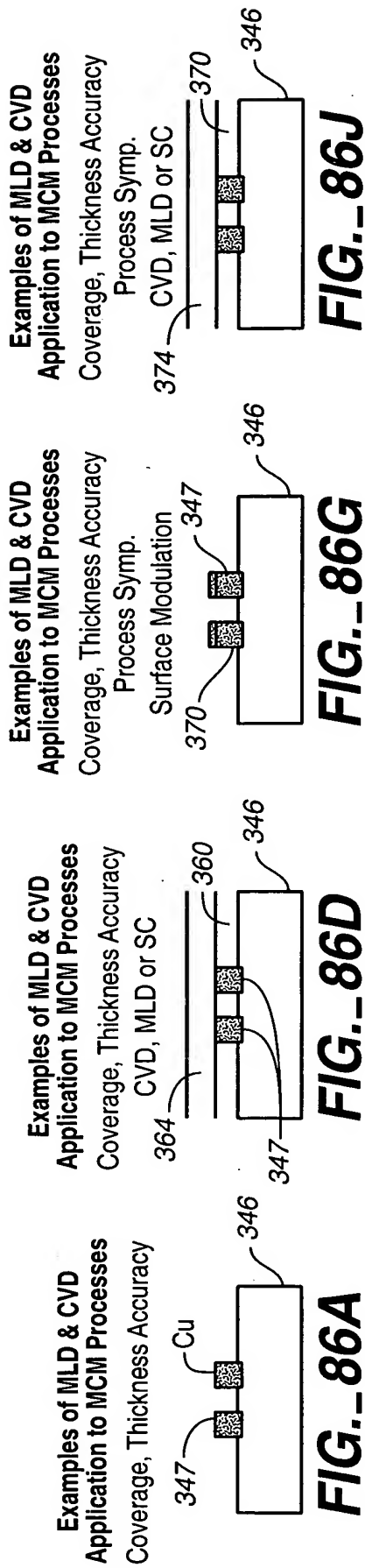
(High & Yes are preferable)

-Conformable coverage and Thickness accuracy / uniformity
-CVD / MLD are superior to Spin Coating

-Low ϵ insulator with strong adhesion
-MLD may provide high adhesion with the Molecular-Level Controllability

-Options
-CVD / MLD can do #Selective Deposition (hydrophilic / hydrophobic surface)
#Selective Molecular Alignment (surface treatment)
may provide further ϵ reduction, process simplification, and low Cu-diffusion

FIG._85H



Examples of MLD & CVD
Application to MCM Processes

Low ϵ Thin Film
Strong Adhesion

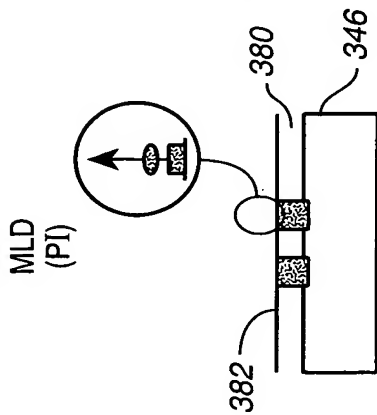


FIG. 86M

Examples of MLD & CVD
Application to MCM Processes

Low ϵ Thin Film
Strong Adhesion

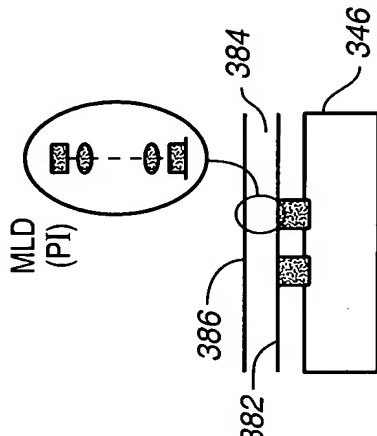


FIG. 86O

Examples of MLD & CVD
Application to MCM Processes

Low ϵ Thin Film
Strong Adhesion

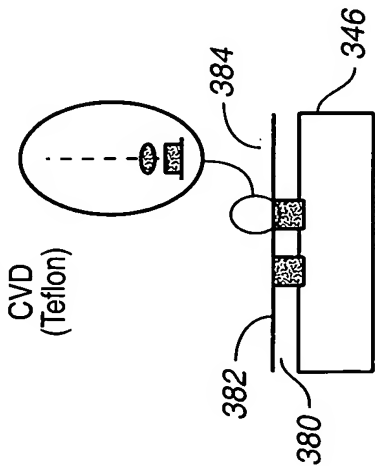


FIG. 86N

Examples of MLD & CVD
Application to MCM Processes

Low ϵ Thin Film
Strong Adhesion

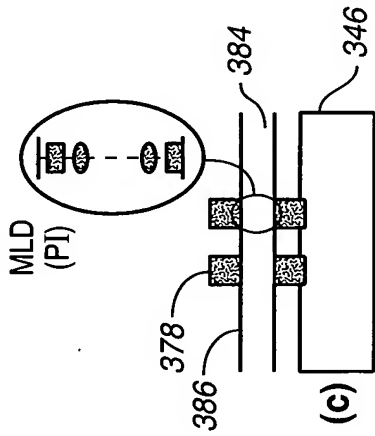


FIG. 86P

Examples of MLD & CVD
Application to MCM Processes

Low ϵ Thin Film
Further Reduction

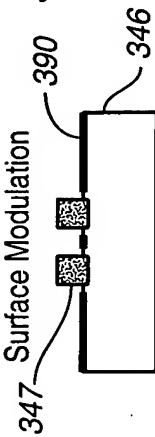


FIG. 86Q

Examples of MLD & CVD
Application to MCM Processes

Low ϵ Thin Film
Further Reduction

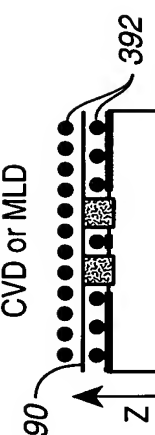


FIG. 86T

Examples of MLD & CVD
Application to MCM Processes

Low ϵ Thin Film
Further Reduction

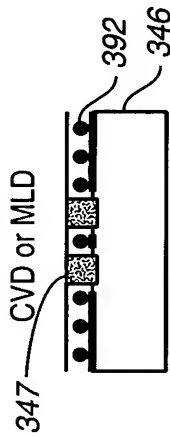


FIG. 86R

Examples of MLD & CVD
Application to MCM Processes

Low ϵ Thin Film
Further Reduction

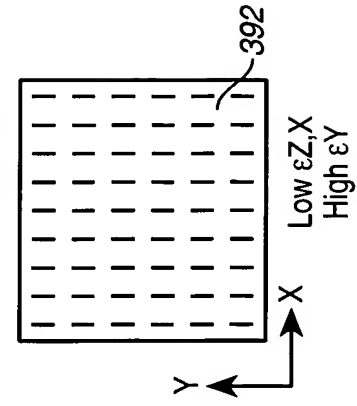


FIG. 86U

Examples of MLD & CVD
Application to MCM Processes

Low ϵ Thin Film
Further Reduction

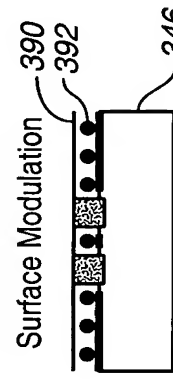


FIG. 86S

Examples of MLD & CVD
Application to MCM Processes

Low ϵ Thin Film
Further Reduction

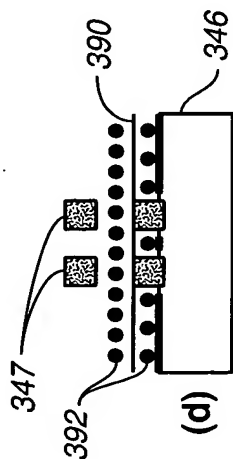


FIG. 86V

Examples of MLD & CVD
Application to MCM Processes

Low Water Absorption
Low Cu-Diffusion
Appropriate CTE
 ϵ -modulation

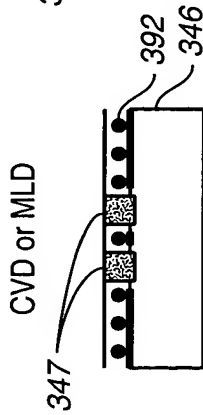


FIG. 86X

Examples of MLD & CVD
Application to MCM Processes

Low Water Absorption
Low Cu-Diffusion
Appropriate CTE
 ϵ -modulation

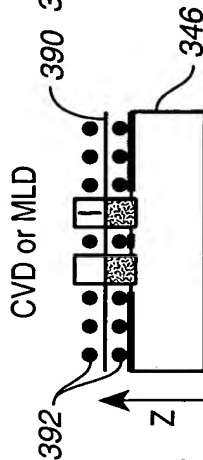


FIG. 86Z

Examples of MLD & CVD
Application to MCM Processes

Low Water Absorption
Low Cu-Diffusion
Appropriate CTE
 ϵ -modulation

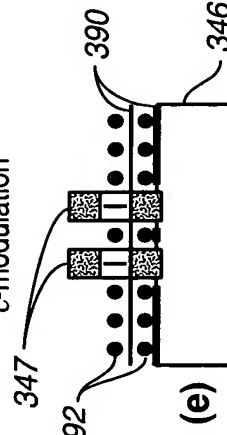


FIG. 86BB

Examples of MLD & CVD
Application to MCM Processes

Low Water Absorption
Low Cu-Diffusion
Appropriate CTE
 ϵ -modulation

Surface Modulation

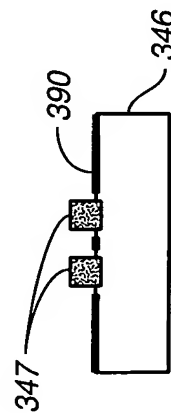


FIG. 86W

Examples of MLD & CVD
Application to MCM Processes

Low Water Absorption
Low Cu-Diffusion
Appropriate CTE
 ϵ -modulation

Surface Modulation

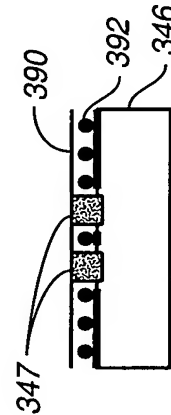


FIG. 86Y

Examples of MLD & CVD
Application to MCM Processes

Low Water Absorption
Low Cu-Diffusion
Appropriate CTE
 ϵ -modulation

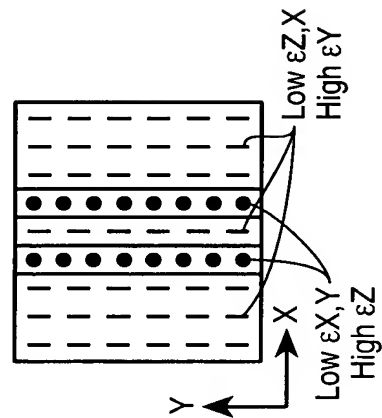
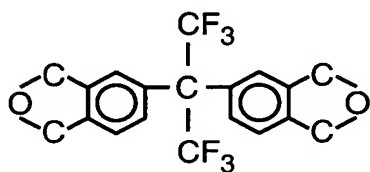


FIG. 86AA

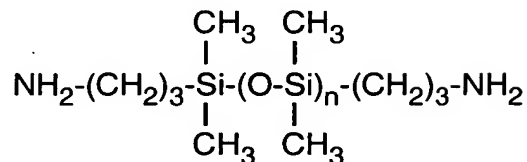
PMDA

naphthalene dianhydride (ND)

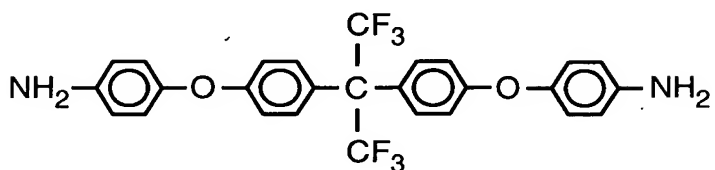


6FDA

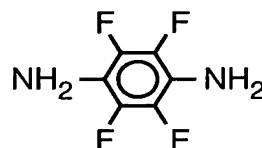
ODA



SiDA



Bis-OAF



VT4-DA

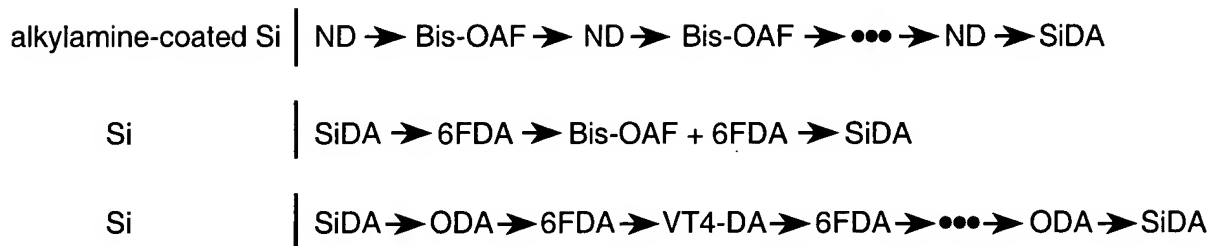


FIG._86CC

Process Flow of the Resist-free Electroplated Solder Reflow Process

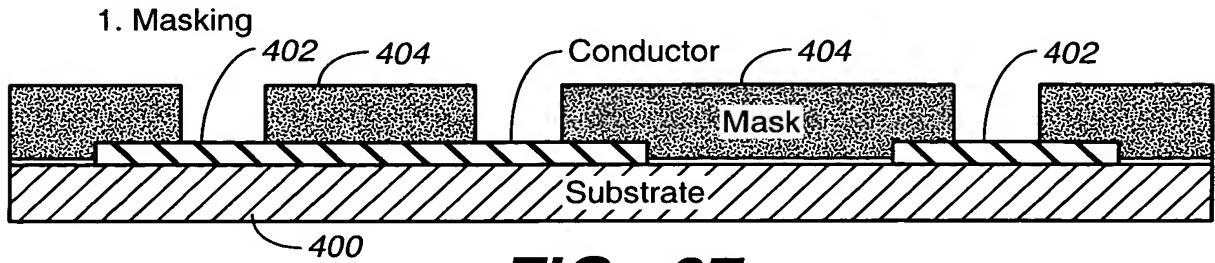


FIG._87

Process Flow of the Resist-free Electroplated Solder Reflow Process

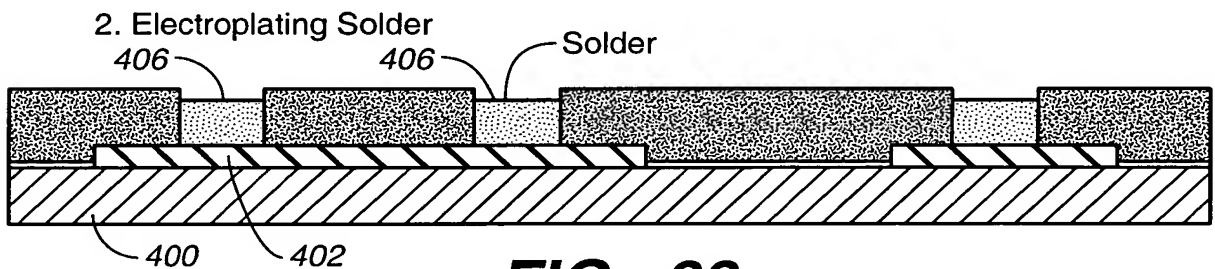


FIG._88

Process Flow of the Resist-free Electroplated Solder Reflow Process

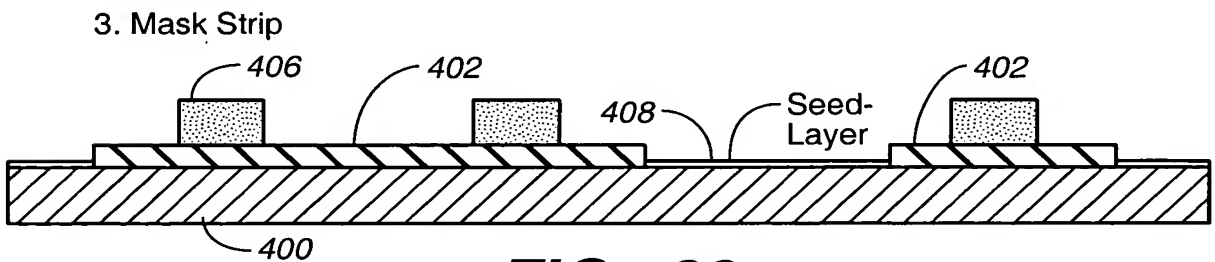


FIG._89

Process Flow of the Resist-free Electroplated Solder Reflow Process

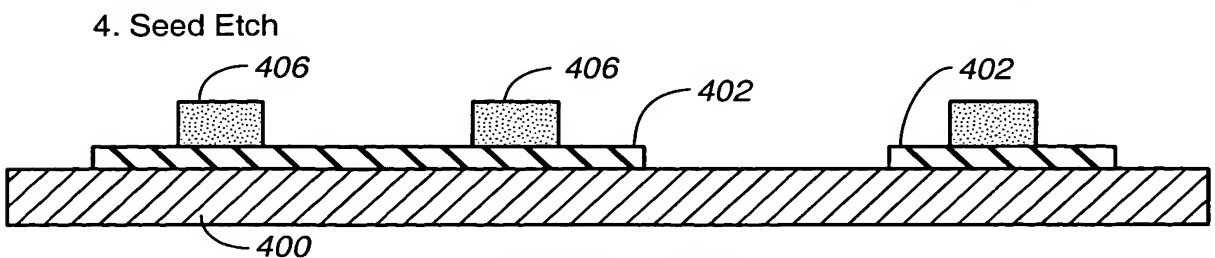


FIG._90

Process Flow of the Resist-free Electroplated Solder Reflow Process

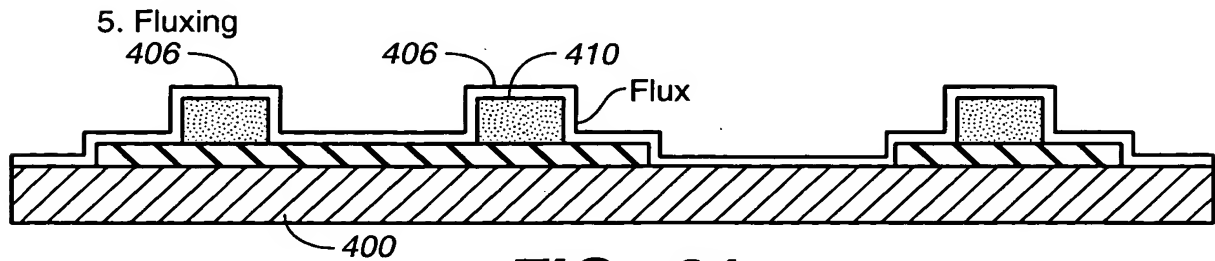


FIG._91

Process Flow of the Resist-free Electroplated Solder Reflow Process

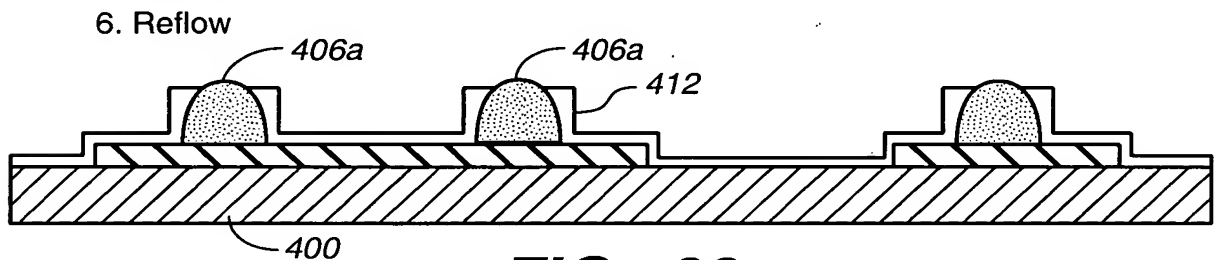


FIG._92

Process Flow of the Resist-free Electroplated Solder Reflow Process

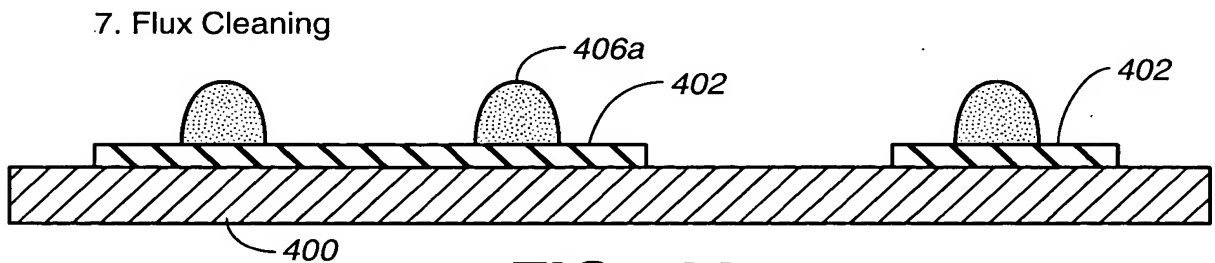


FIG._93

Geometric Dimensions of
the Electroplated Bumps

Top View

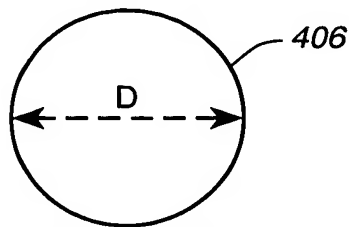


FIG._94

Geometric Dimensions of
the Electroplated Bumps

Top View

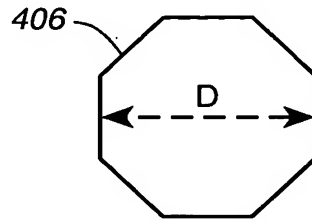


FIG._95

Geometric Dimensions of
the Electroplated Bumps

Side View

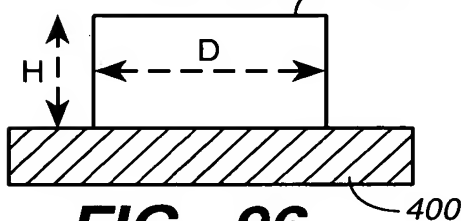


FIG._96

Geometric Dimensions of
the Electroplated Bumps

Side View

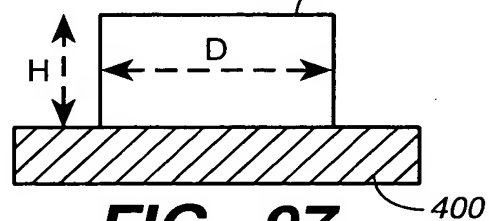


FIG._97

Geometric Shape Change of Electroplated
Solder Bumps by Reflow Process

Before
Reflow

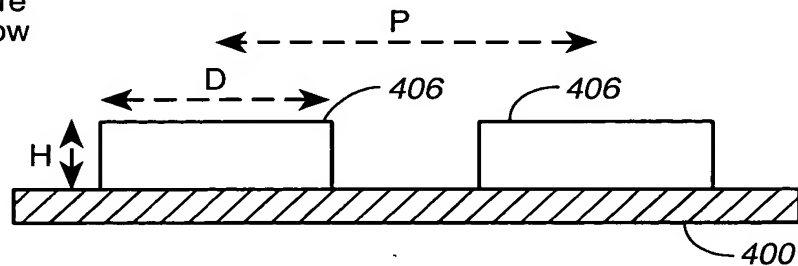


FIG._98

Geometric Shape Change of Electroplated
Solder Bumps by Reflow Process

After
Reflow

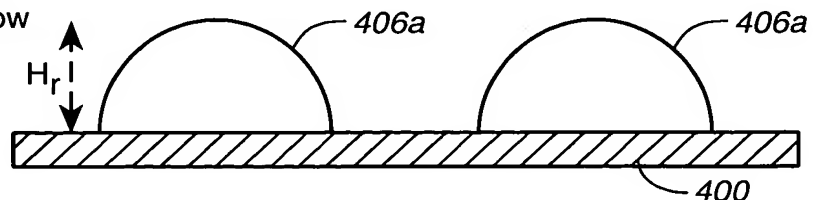


FIG._99

Schematic Drawing of Bridged Bumps

Bridged
Bumps

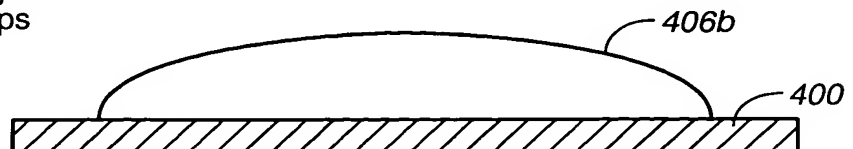


FIG._100

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Direct Plating Process

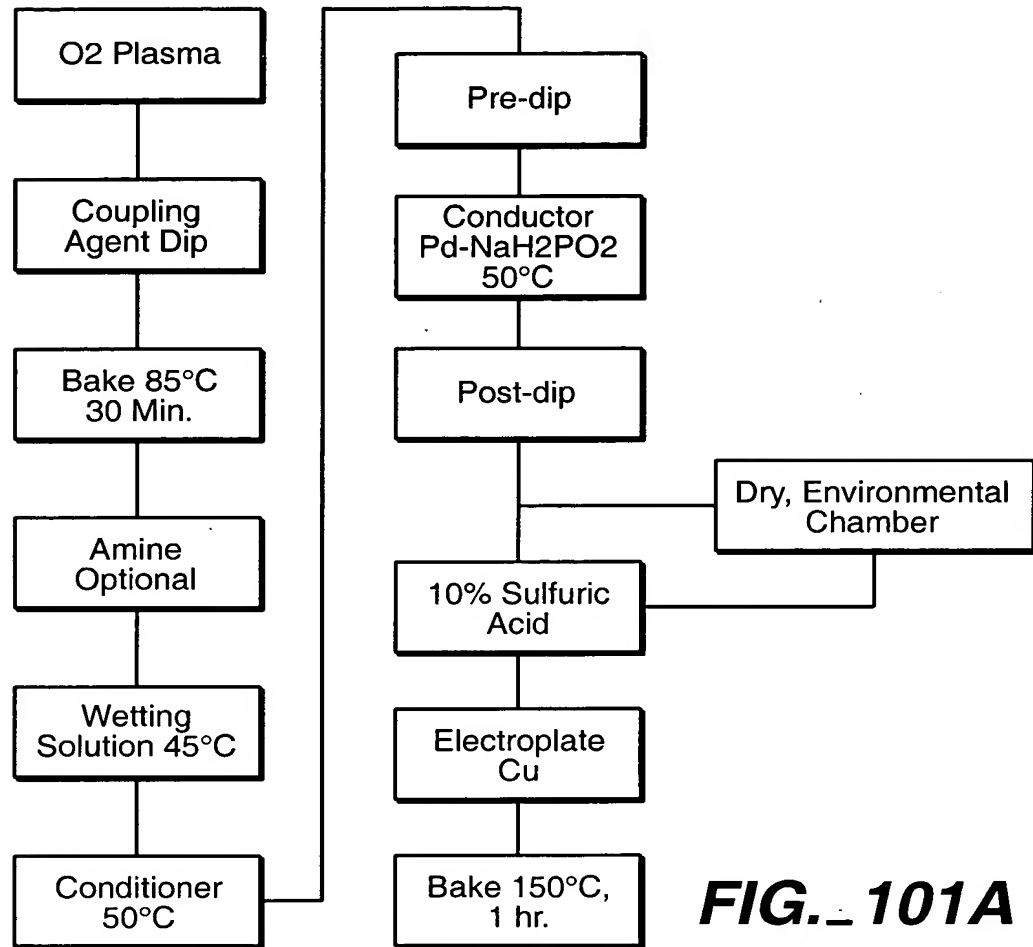


FIG._101A

Stencil Frame Layout

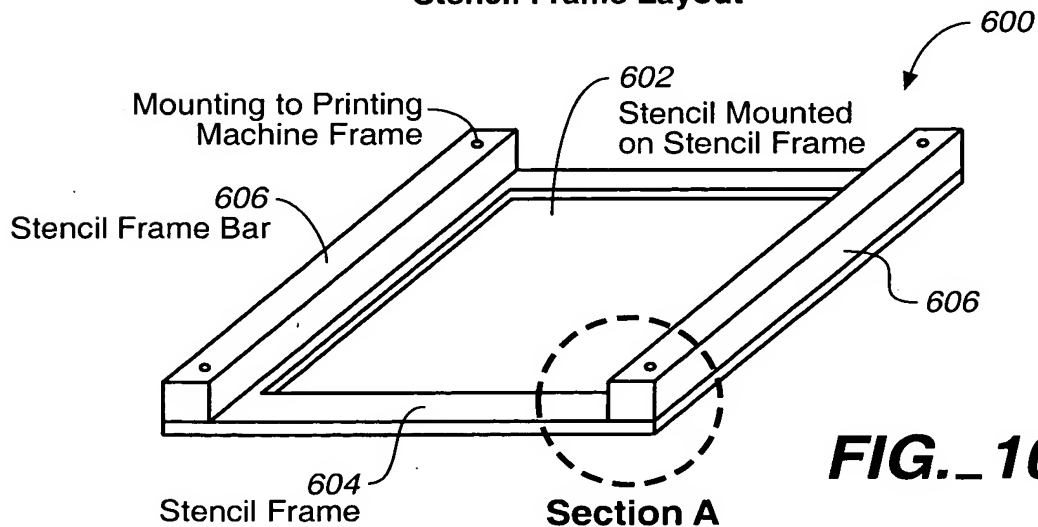
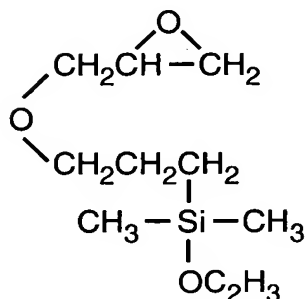
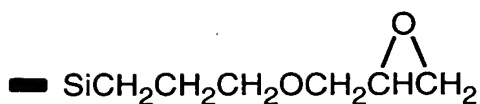
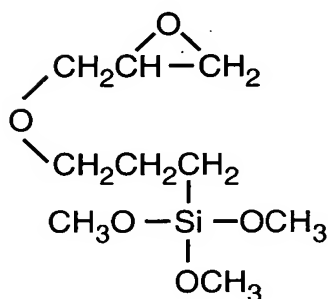


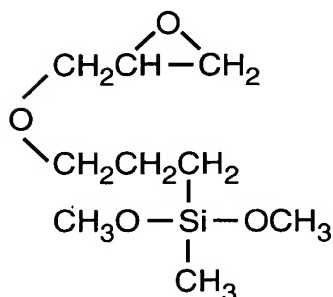
FIG._102



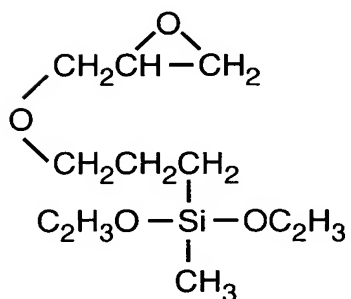
(3-GLYCIDOXYPROPYL)DIMETHYLETHOXY-
SILANE
C₁₀H₂₂O₃Si



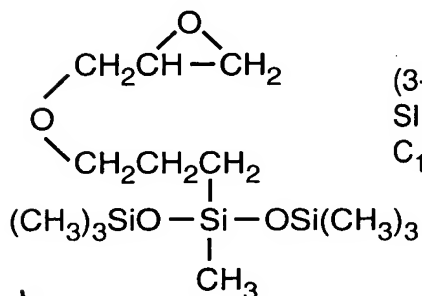
(3-GLYCIDOXYPROPYL)TRIMETHOXY-
SILANE
3-(2,3-EPOXYPROPOXY)PROPYLTRIMETHOXY-
SILANE
C₉H₂₀O₅Si



(3-GLYCIDOXYPROPYL)METHYLDIMETHOXY-
SILANE
C₉H₂₀O₄Si

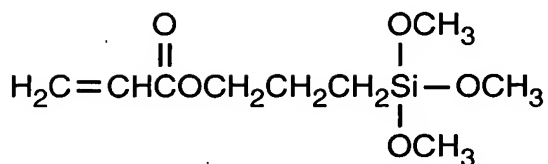


(3-GLYCIDOXYPROPYL)METHYLDIETHOXY-
SILANE
C₁₁H₂₄O₄Si

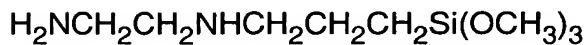


(3-GLYCIDOXYPROPYL)BIS(TRIMETHYL-
SILOXY)METHYLSILANE
C₁₃H₃₂O₄Si₃

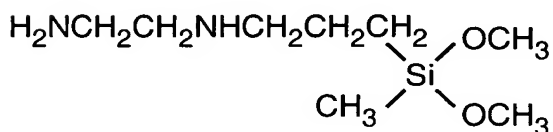
FIG. 101B-1



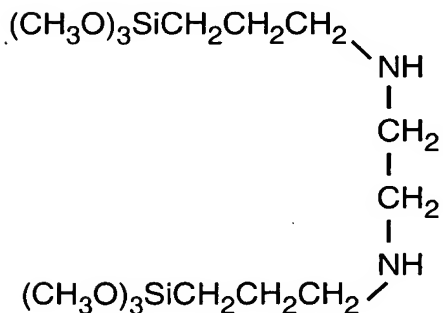
(3-ACRYLOXYPROPYL)TRIMETHOXY-
SILANE, 95%
 $\text{C}_9\text{H}_{18}\text{O}_5\text{Si}$



N-(2-AMINOETHYL)-3-AMINOPROPYLTRI-
METHOXY-SILANE
 $\text{C}_8\text{H}_{22}\text{N}_2\text{O}_3\text{Si}$



N-(2-AMINOETHYL)-3-AMINOPROPYLMETHYL-
DIMETHOXY-SILANE
 $\text{C}_8\text{H}_{22}\text{N}_2\text{O}_2\text{Si}$



BIS(3-TRIMETHOXY-SILYL)PROPYL]-
ETHYLENEDIAMINE,
 $\text{C}_{14}\text{H}_{36}\text{N}_2\text{O}_6\text{Si}_2$

FIG. 101B-2

Section View of Stencil Frame Components

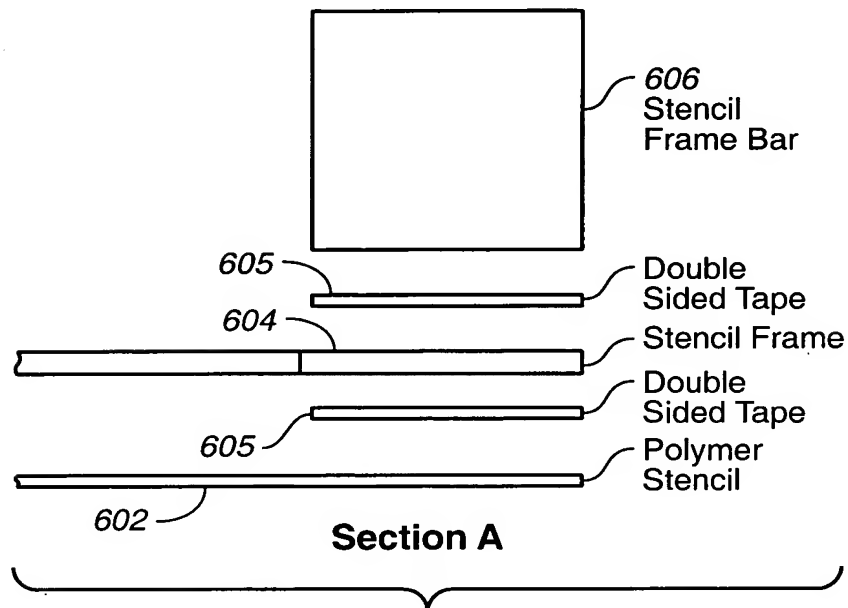


FIG. 103

Tapped Hole in Stencil Frame Bar

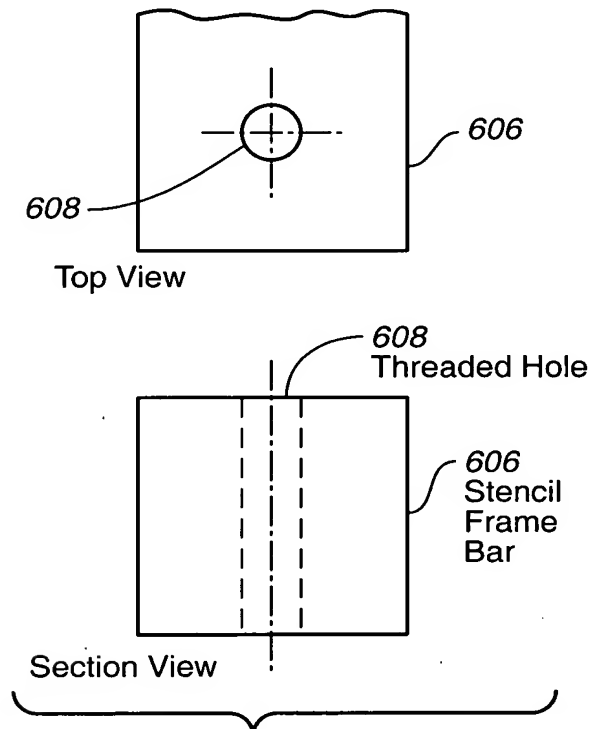


FIG. 104

Traditional Joining

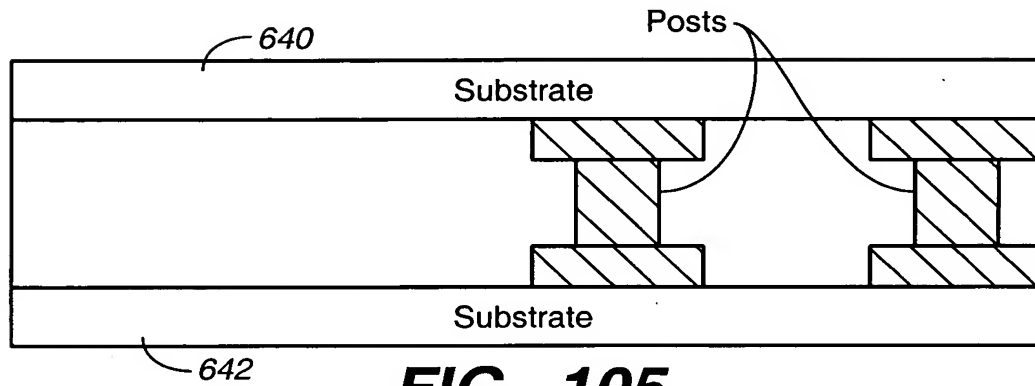


FIG._105

Alignment and Holding Using Long Pin

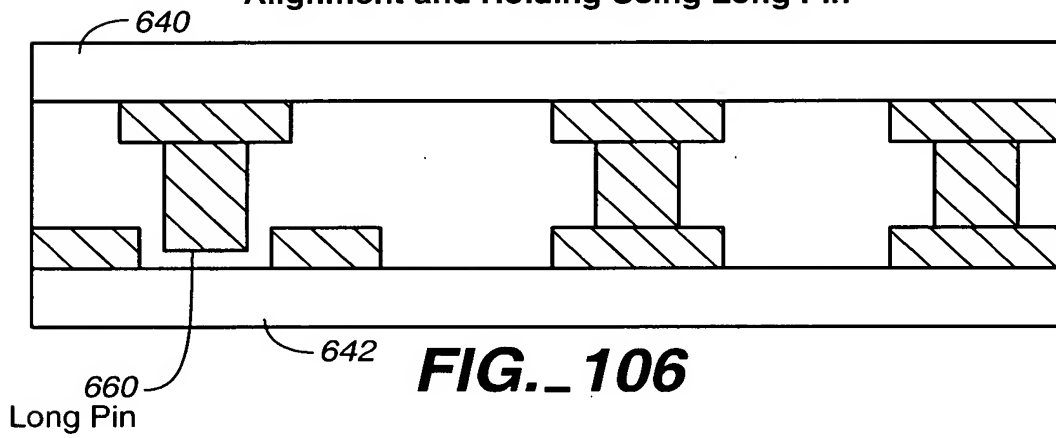


FIG._106

Alignment and Holding Using Thick Pads

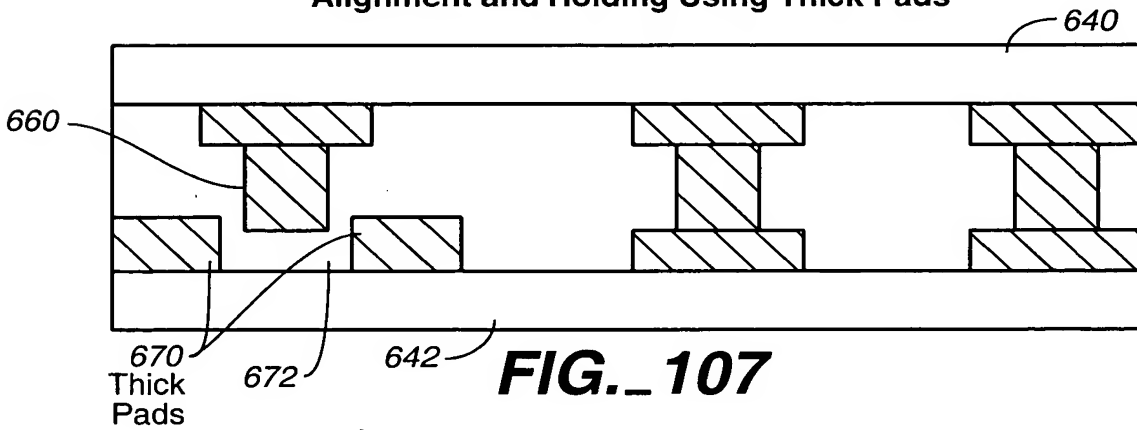


FIG._107

Build-up Process for Long Pin

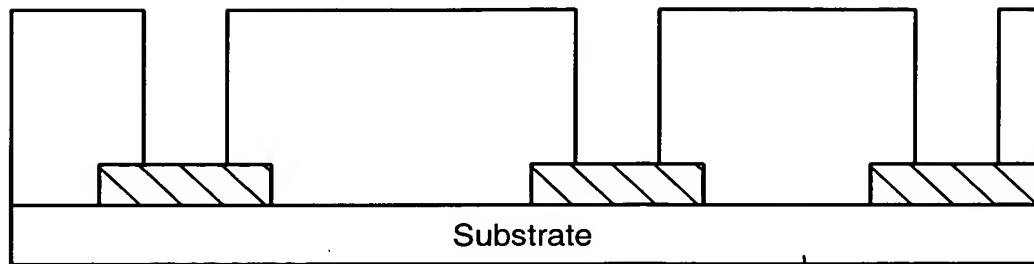


FIG. 108

Build-up Process for Long Pin

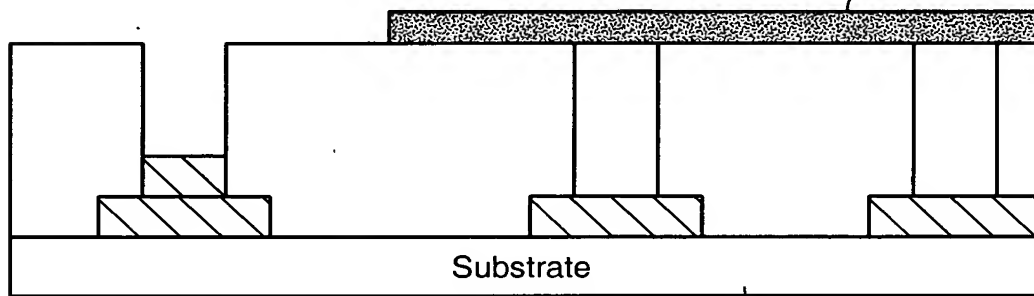


FIG. 109

Build-up Process for Long Pin

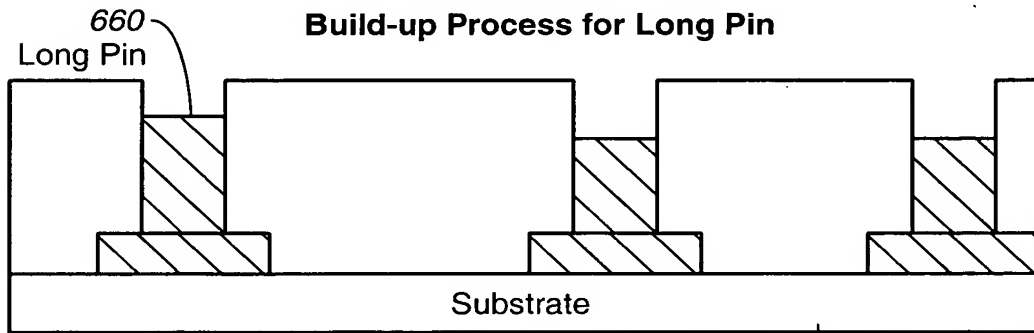


FIG. 110

Another Build-up Process for Long Pin

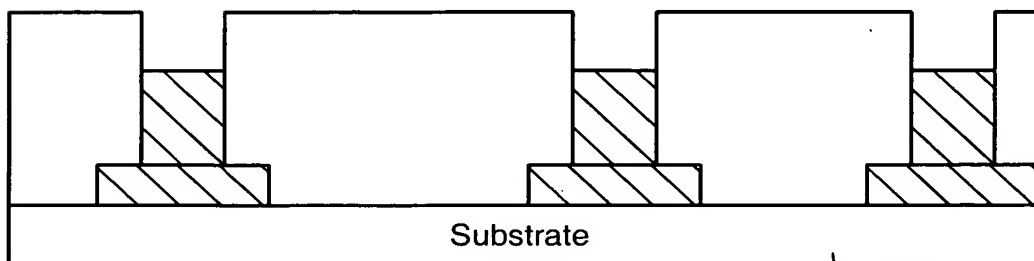
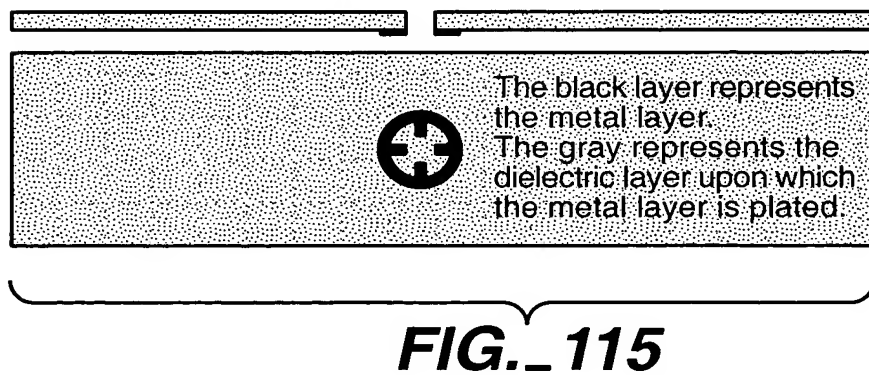
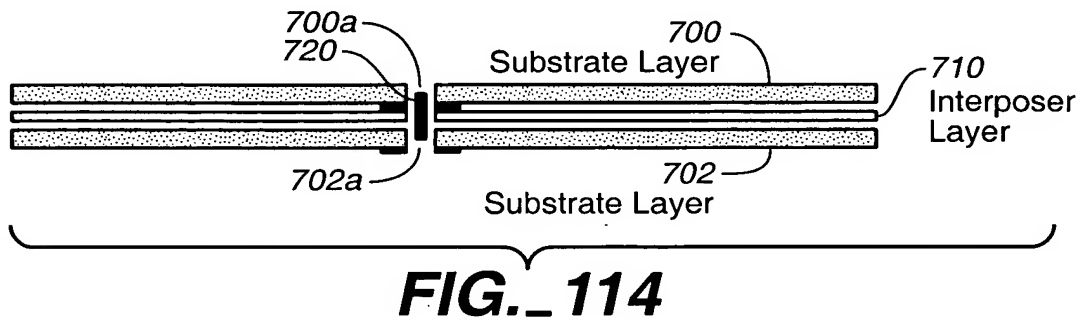
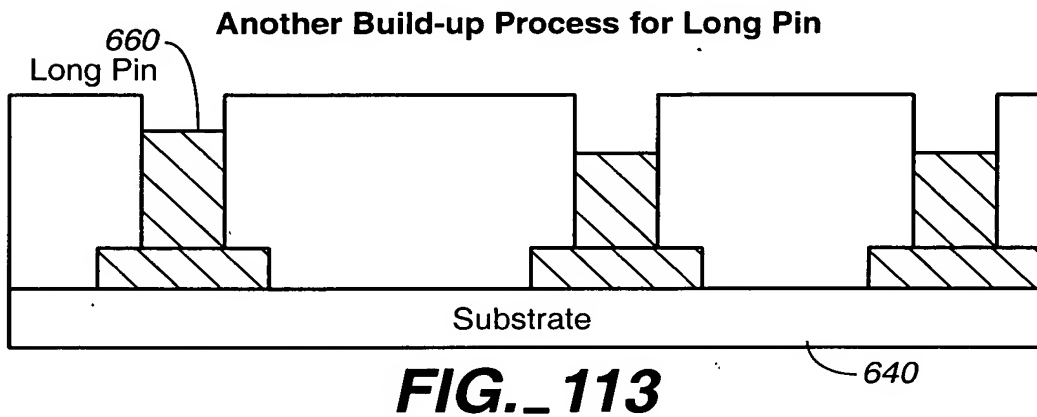
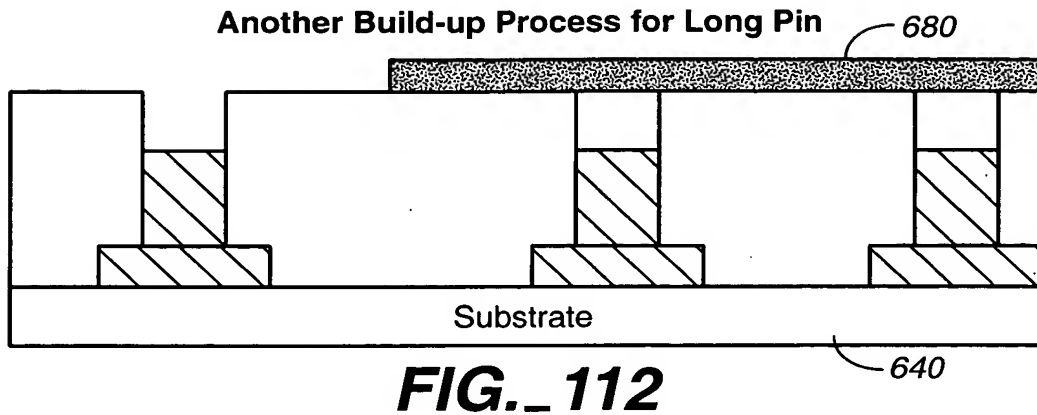


FIG. 111



The black layer represents
the metal layer.
The gray represents the
dielectric layer upon which
the metal layer is plated.

Transient liquid alloy bonding process with separate bonding phases.

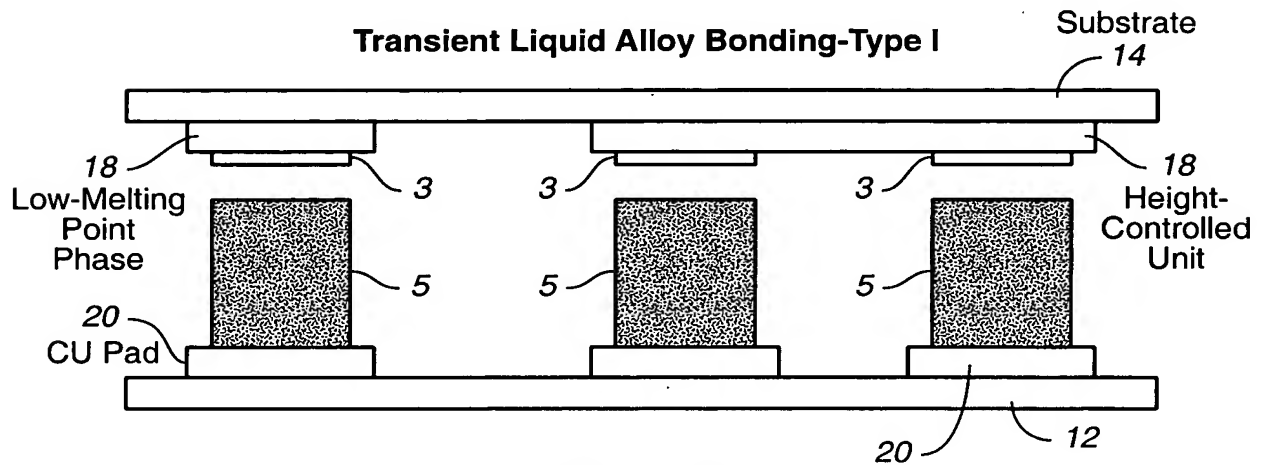


FIG._116

Transient liquid alloy bonding process with one side bonding phases.

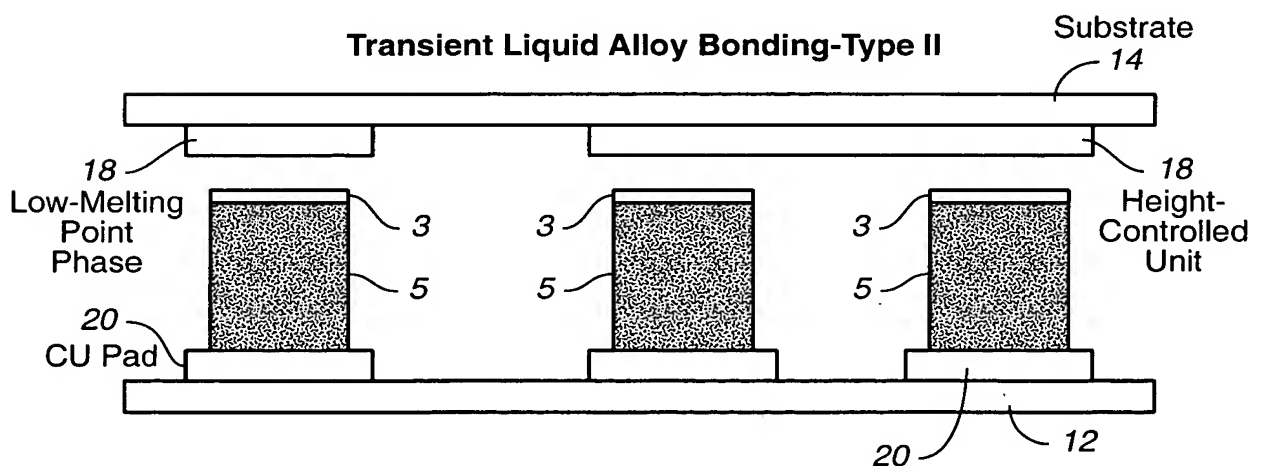


FIG._117

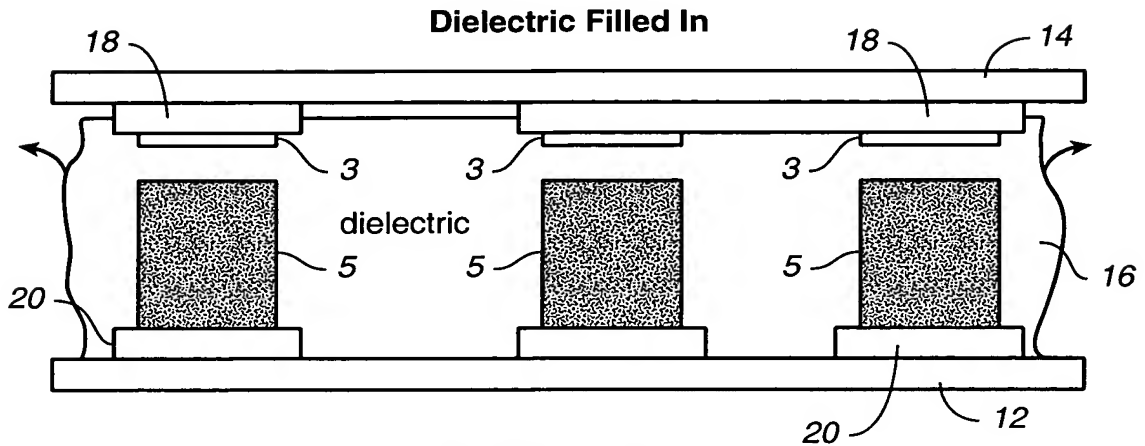


FIG._118

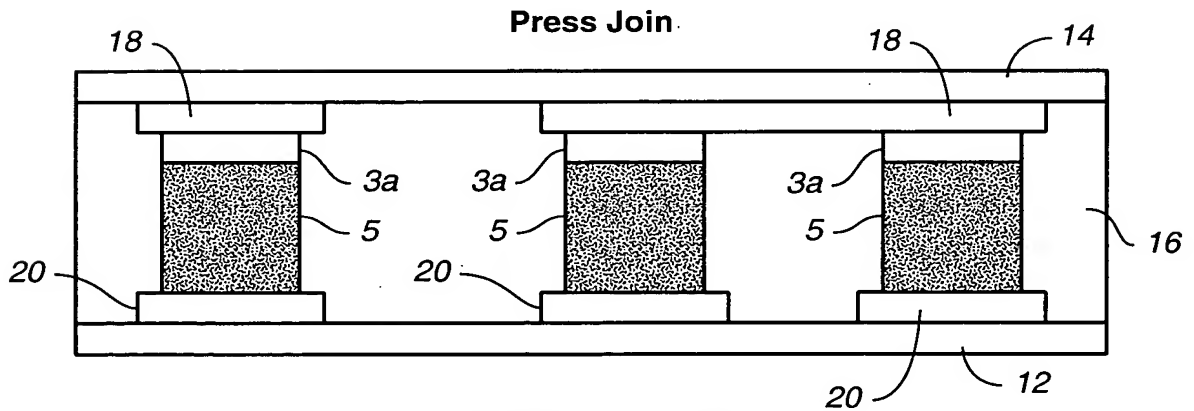


FIG._119

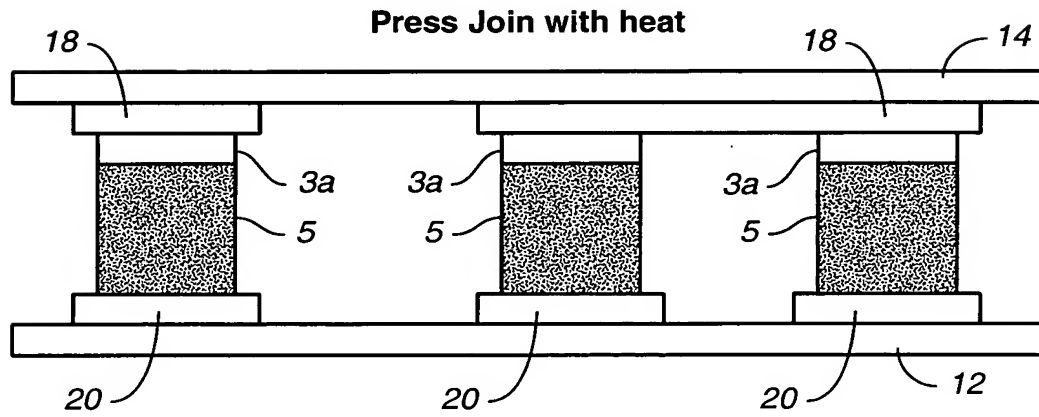


FIG._120

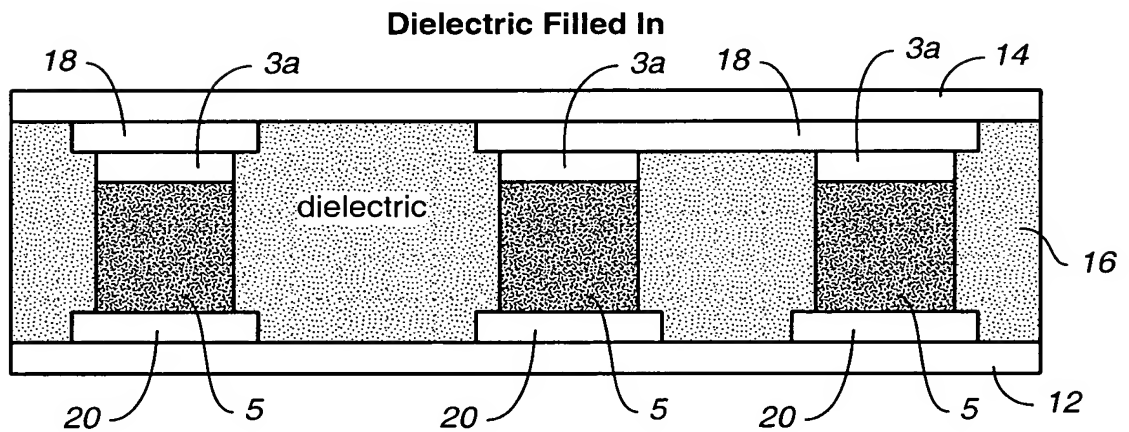


FIG._121

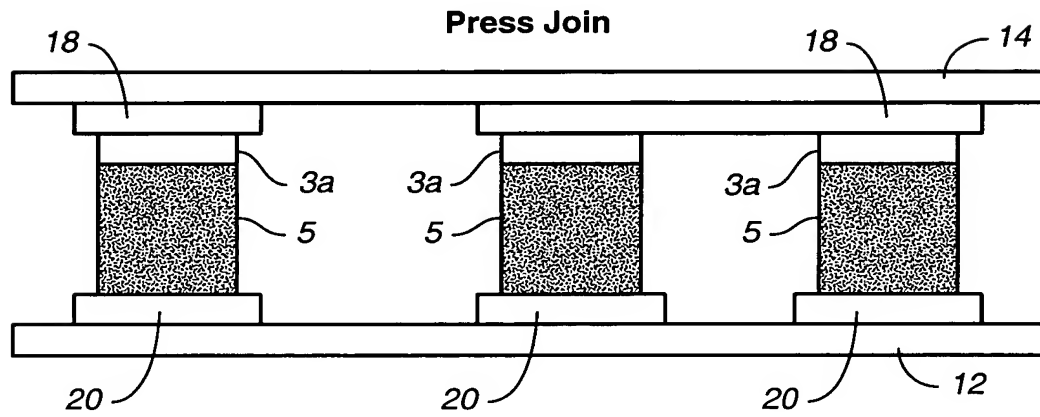


FIG. 122

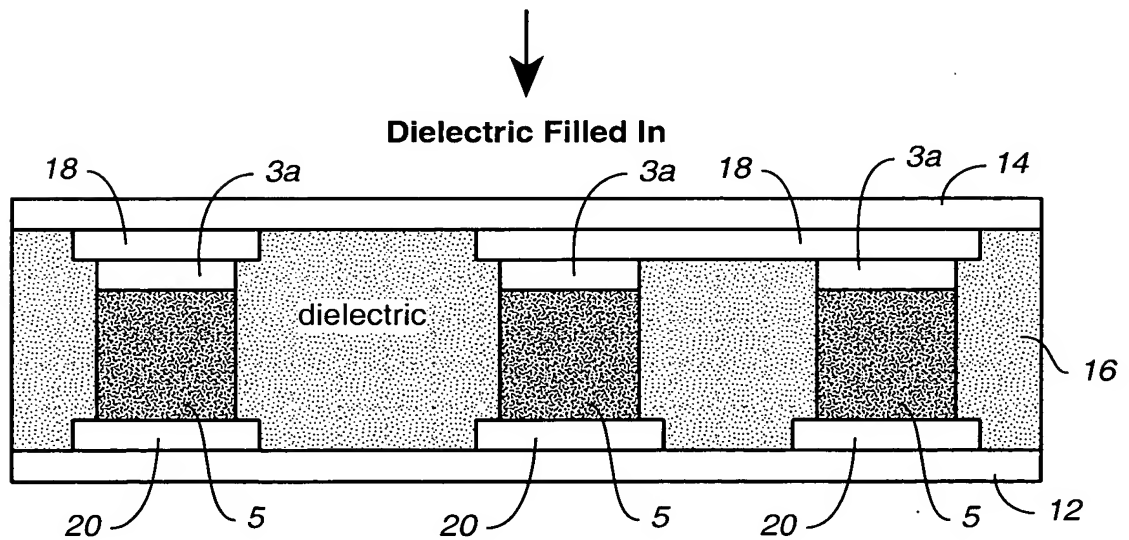


FIG. 123

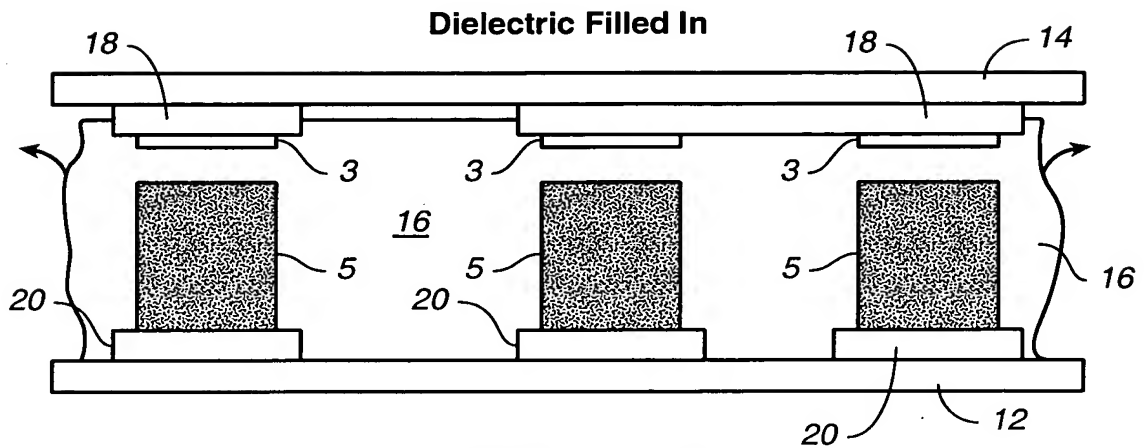


FIG. 124

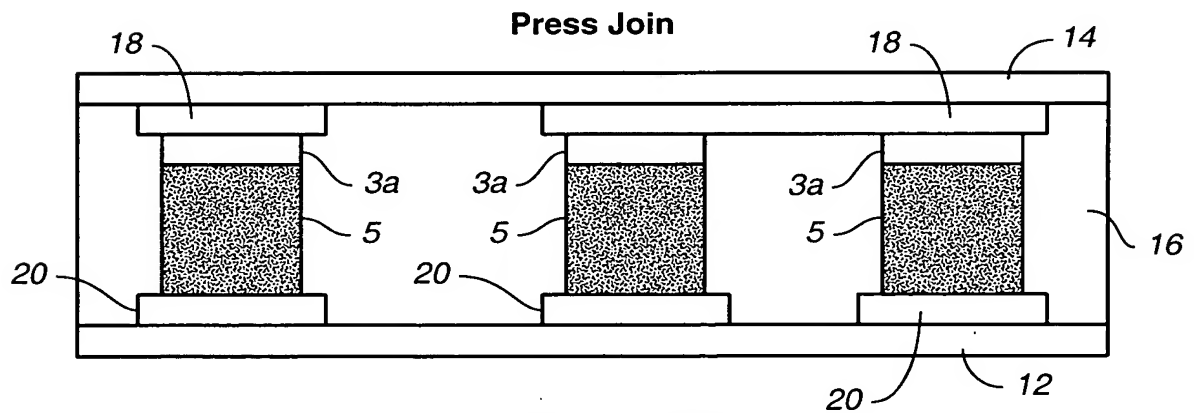


FIG. 125

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